THE GARDEN JOURNAL

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THE NEW YORK BOTANICAL GARDEN

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THE GARDEN JOURNAL

DOROTHY EBEL HANSELL, *Editor*

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Front-cover illustration—*Yucca filamentosa* at The New York Botanical Garden, p. 40 Walter Singer; pp. 2, 3, 4, 5, Samuel H. Gottscho; pp. 6, 7, 8, H. Gilbert Harlow; pp. 9, 10, Homer L. Jacobs; p. 12, lower left, p. 13, National Portrait Gallery, Smithsonian Institution; pp. 15, 16, 18, David G. Leach; pp. 26, 27, 28, 29 courtesy Lawrence J. Crockett; pp. 30, 31, 32, 33, Herman F. Becker; pp. 34, 35, Thomas H. Jukes; p. 36, Richard B. Fischer.

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PHOTOGRAPHY
A GLORIOUS ADVENTURE

By SAMUEL H. GOTTSCHO

PHOTOGRAPHY IN MY LIFE has been a glorious and noble adventure. As I recall and reflect on my very young days, I believe it was destined to play an important part in my life over the years.

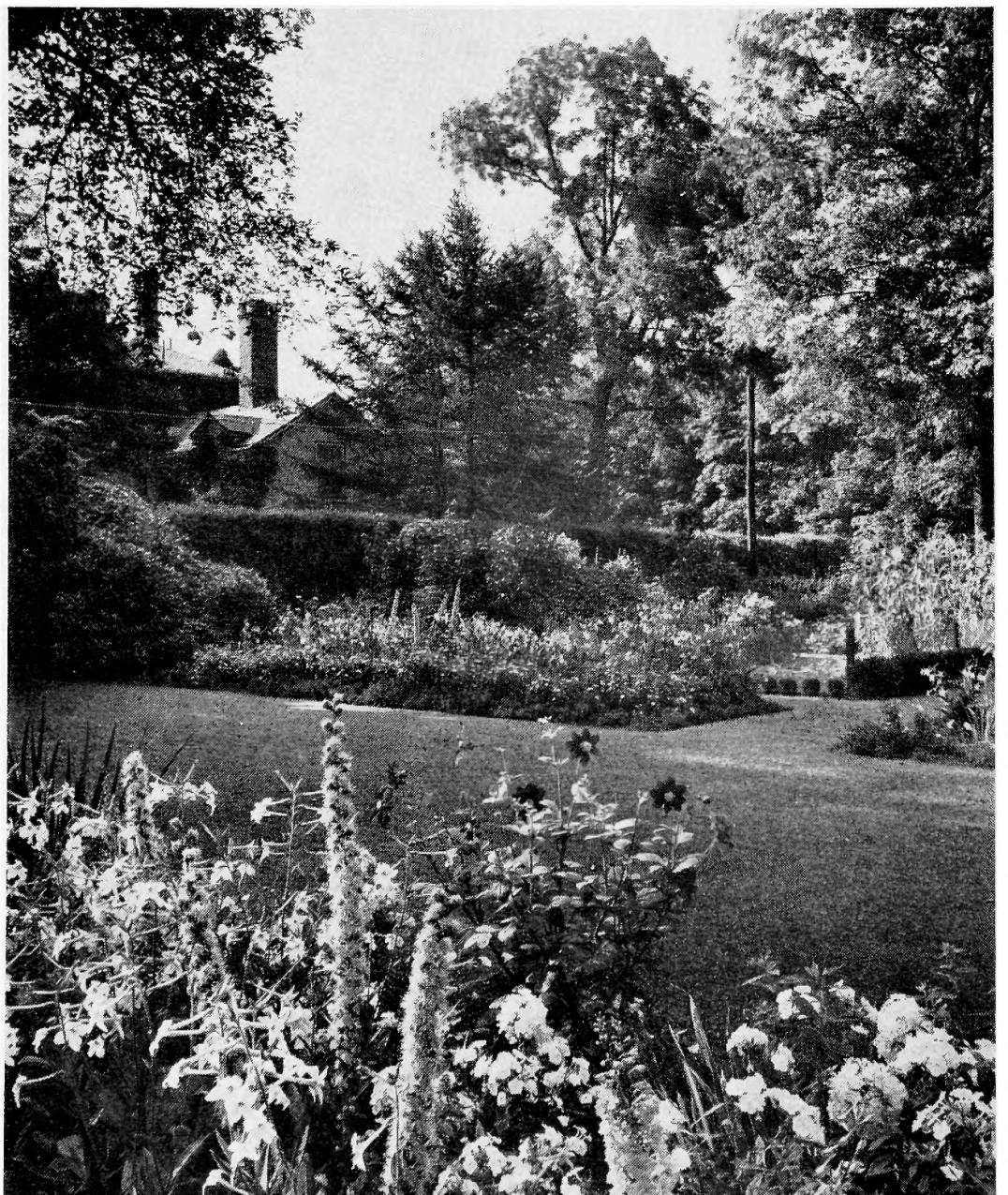
I am deeply grateful that it rescued me from an inglorious middle and old age, and for the pleasure I have derived not alone from my professional work as a photographer of houses and gardens, but from my avocation of picturing nature and wild flowers.

I was born in Brooklyn on February 8, 1875, the son of a German father and an American mother of French descent. As a boy I delighted in our summer vacations in the country and looked forward to the ending of each school year, so that I could again enjoy the pleasures of living in the country—in short, I was in love with nature from my earliest years.

I first became acquainted with photography in 1896 at the age of twenty-one. I had a camera then, best described as a box camera taking 4x5 glass plates, the grand-daddy of the later box Brownie camera of which several million were sold to aspiring "cameraists" at $2.00 each.

My first pictures were taken in the countryside, the roads, lakes, ponds, and brooks, somewhat prophetic of the subjects which later intrigued me. My occupation from 1900 to 1925 was that of a traveling salesman. I was away from home many weekends, which were spent in small country towns, and their trolley cars brought me out to the nearby woods and fields every Sunday.

Early in 1925 I decided to become a professional photographer. My good wife gave me every encouragement, and on May 18 of that year I was launched on my career. This second life began at the age of fifty. And what wonderful years have been the next forty-



An early garden picture in Philadelphia taken by Mr. Gottscho for Helen Van Pelt Wilson. It illustrates his favorite approach to any large garden, shooting across from one border to the other. The exceptional bloom in the foreground was not unusual those days, when garden maintenance was not a problem, and the glimpse of the house peeping through the trees is a most fitting background.

Mr. Gottscho says, "Of all garden flowers, I believe I like lilies the best, particularly as close-ups. These gold-band lilies, *Lilium auratum*, are truly regal flowers. They were grown by Helen M. Fox, whose gardens I have enjoyed photographing for many years. The direction of the light and the shadows result in a three-dimensional effect most desirable to bring out the beauty of the blossoms."

one! I was most happy in working hard, made my way well up in the profession, and have never had any cause to regret my step.

I had chosen for my field of work architectural photography, specializing in country houses—their exteriors and interiors and gardens—which I still practice today. While from the very beginning I had taken pictures of the garden in relation to the house, it was some fifteen years later before gardens and gardening became very important in my work, which they continue to be today.

My real interest in wild flowers began in the spring of 1943 when Dorothy H. Jenkins introduced me to the Fairchild Wildflower Garden, which is now part of the Audubon Nature Center at North Greenwich, Connecticut. It was there and then that I fell in love with wild flowers. The date was May 19, and it was on that day, the first of my many visits there, that I photographed in color a few yellow lady's-slippers, *Cypripedium parviflorum,* growing against a tree stump in the woods. This picture was selected as a color cover for *The Garden Journal* of The New York Botanical Garden, May-June, 1964, and was also used for the jacket of my book *How to Know and Enjoy Wildflowers*, published by Dodd Mead in 1952.

During the summer of 1943 my work with wild flowers continued on my usual Adirondack vacation, spent on the eastern shore of Schroon Lake. The gas rationing of World War II was in effect and instead of traveling at forty miles per hour about the countryside, I was obliged to walk the dirt roads within a few miles of the hotel. Here grew all kinds of treasures which could be easily observed and pictured at the side of the road. I recall a stand of some thirteen purple fringed orchis *(Habenaria psycodes)* blooming in perfumed splendor in a roadside ditch, and I salute the dirt road so rapidly disappearing as a happy hunting ground to observe nature and wild flowers close at hand.

Since 1943 I have spent all spare time from my professional photography and my entire time on vacations

Ths black and white picture is made from a negative of a 2¼ x 2¼ color transparency, which was chosen as the illustration on the box for Volume 1 of *Wildflowers of the United States*, as well as for a full page in the book. The resulting black and white print of this swamp rose mallow, *Hibiscus palustris*, is an excellent reproduction. The contre-jour lighting makes this picture, which was taken in Southold, Long Island, where these mallows bloom in August in stands of unforgettable beauty.

The original of this photograph was a 28 x 40 mm. color slide, slightly larger than the 35 mm. It was taken on the dank and dark floor of an Adirondack woodland. The dim light is shown by the elongated stems of the tiny fungi; the picture required an exposure of fourteen seconds, during which the little red eft posed beautifully. This was the second exposure; the eft had permitted Mr. Gottscho to handle and turn him completely around, thus creating a better composition.

The showy lady's slipper, *Cypripedium reginae.*
Mr. Gottscho, who considers this one of his finest wild flower pictures, both in black and white and in color, comments, "I was obliged to photograph these flowers against the light, due to their location—a procedure I have chosen to use more and more, realizing that the delineation of form is as equally important as obtaining good color rendition. In this picture the outline of leaves by backlighting results in a subject of compelling charm."

in the pursuit and enjoyment of wild flowers, which interest is deeply shared by my daughter, Doris Schleisner. I have photographed them in color transparencies and in black and white, as part of the landscape and terrain in which they grow, as portraits of plants, and as close-ups of single blossoms. I have studied and read about them and through the years have collected several hundred fascinating books about wild flowers, many of which, unfortunately, are now out of print.

Although since 1940 I have photographed many gardens, greenhouses, and horticulture in general in great numbers in my professional work, yet my heart belongs to the wildlings, because of their sturdy independence and ability to make their way without any attention from man, even overcoming the many handicaps placed in their way.

TUBEROUS BEGONIAS

By H. GILBERT HARLOW

H. Gilbert Harlow, a professor of engineering at Union College, in Schenectady, New York, has spent twenty years in developing a new strain of tuberous begonias particularly adapted to the climate of the northeastern United States. He serves as National Chairman of the tuberous begonia test program of the Men's Garden Clubs of America.

An important characteristic of a good seedling tuberous begonia is a stiff stem which will hold the large blooms well above the foliage.

FEW GARDEN SUBJECTS can compete with tuberous begonias for sheer breath-taking beauty. Whether they are displayed in beds, used as specimen plants in individual containers, or grouped in planters and window boxes, their effect is equally impressive. The purity and depth of color are remarkable, and the form of a superior flower is so letter-perfect that one must constantly assure observers that they are real.

Tuberous begonias are a tribute to the hybridizers of the past one hundred years who started with a half-dozen wild species and transformed them into the splendid hybrids of today. All the original species which contributed to the present strains were native to the high elevations of the Andes Mountains, growing in a climate which was cool and moist. These wild plants were single or semidouble, and there was abundant pollen to assure natural pollination and perpetuation of the species through seeding. Typical of them is *Begonia pearcei*, an ancestor of all the modern yellow hybrids; it has a small single flower, perhaps an inch across and resembling a flattened buttercup. The other species are equally modest, and it is difficult to believe that a hundred years of successive crossing, selecting, and crossing again could produce the gigantic, fully double, beautiful tuberous begonias which are available from good suppliers today.

Unfortunately these begonias are often excluded from gardens because of the false notion that they are difficult to grow. While it is true that their requirements are somewhat different from many commonly grown flowers, they are no more demanding in terms of time or attention than a bed of petunias or snapdragons. On the plus side they offer a season of bloom extending from June until frost, and they can be grown in locations where an equally colorful display cannot be obtained from any of the usual bedding plants.

To understand the cultural requirements of the tuberous begonia or any other garden subject, it is sensible to consider first the climate where the plant grows naturally. While few of us can duplicate the Andes environment, we can at least select that portion of our garden which comes closest to being cool and moist. Providing moisture does not necessarily mean watering daily. A mulch will keep the soil in most gardens moist for a week and at the same time provide insulation to keep the soil temperature down. Mulching prevents heavy rains from splashing the leaves and flowers with dirt and soil-disease organisms, and it also prevents the rain from packing the soil and reducing the air content necessary for good root growth. It is much more important to mulch than that any particular material be used, excellent results being obtained with grass clippings, cocoa shells, buck-wheat hulls, and peat moss.

While we cannot make it cool in the garden when the weather is hot, we can at least refrain from planting tuberous begonias where the hot afternoon sun will dessicate them. It is in going to the other extreme that many gardeners err. While these plants will grow in dense shade, they will not bloom under this condition. The quantity of bloom varies directly with the light which the plant receives, provided it does not at the same time become overheated by the sun. Ideal conditions are furnished by thin, high, overhead shade. One experienced grower, Oscar Rheingold of East Schodack, New York, plants fifteen hundred seedling begonias on the shady side of a long line of spruces with rather sparse foliage, and the plants grow to perfection. The object in utilizing shade is to allow considerable sun to shine upon the plant but to have moving shadows cool off each area before it overheats. Many growers have outstanding success by planting in beds which receive full sun only in the morning or full sun only in the late afternoon and early evening.

A little-known fact about begonias may be useful to the person growing them for the first time or one whose past experience has been less than rewarding. A tuberous begonia grown in shade will produce very large, deep green leaves under the usual conditions of soil moisture and fertility. The same plant, grown under maximum light conditions, will have smaller and lighter colored leaves and the leaves will have a shinier surface. This is nature's way of adapting to the environment. Through reflection of a portion of the sunlight the plant is able to cope with a marginal situation. If a shade-grown plant were moved abruptly into a sunny location, it would simply expire from the heat on the first bright day. It would also take time for a plant

grown under sunnier conditions to adapt to shade. The practical application of this information is obvious: by early planting in the area where the plant is to grow, we induce the kind of growth that the situation demands. In addition, the plant benefits from the opportunity to form a big root structure before it is called upon to bloom.

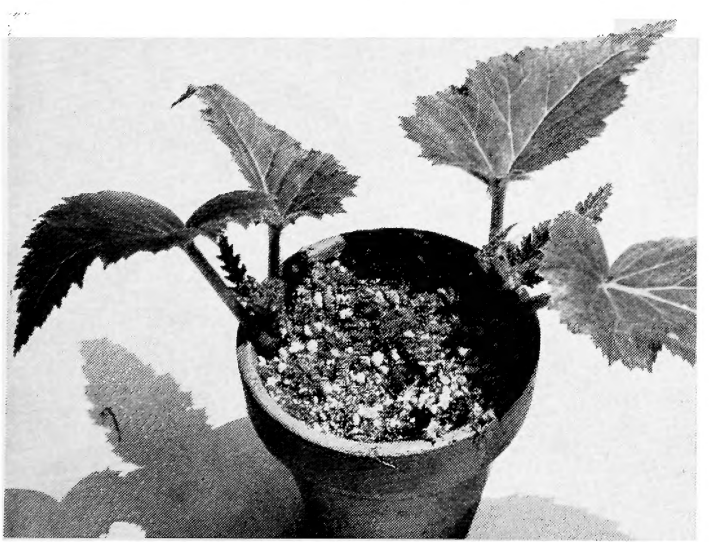
An ideal bed for tuberous begonias consists of five or six inches of rich, humusy soil preferably raised several inches above the surrounding area, or otherwise assured of good drainage. Begonias are shallow-rooted so that deep preparation of the bed required for such plants as roses and sweet peas serves no useful purpose. Almost any existing soil can be made acceptable by incorporating a sufficient quantity of compost, leafmold, vermiculite, perlite, or peat moss. Combinations of these are usually best. The resulting soil should be sufficiently porous so that even after a heavy downpour water will not remain on the surface.

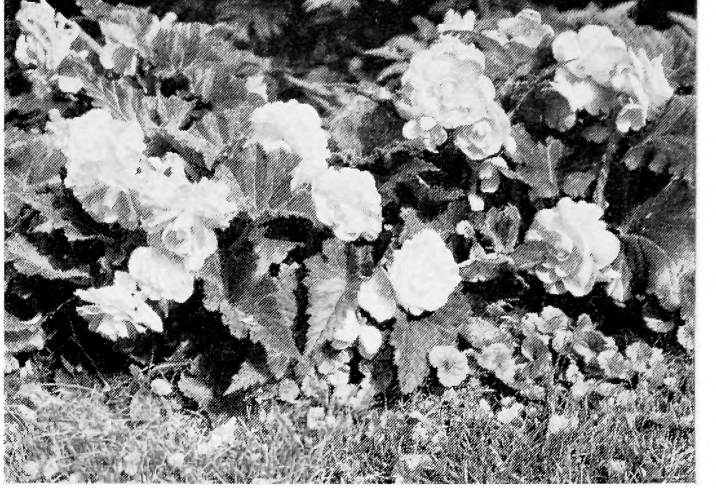
Begonias respond to a sensible fertilizing program. This may be nothing more than a generous application of a high organic fertilizer before planting, or it may be a weekly application of a completely inorganic soluble plant food in very dilute concentration. Fish emulsion or any other liquid organic fertilizer supplied to other plants will give satisfactory results. By observing the color of the leaves a careful grower will learn to recognize symptoms of hunger in a plant, before its growth is seriously checked.

Tuberous begonias are such show-offs that many growers prefer to use containers which can be moved about to brighten up a particular spot. A half-dozen, well-grown specimens at the edge of a patio will often give the effect of a whole garden, even though space for a garden is not available. Three seedling plants of the same color in a single, ten-inch container will develop into what appears to be a single, large plant with many flowers open simultaneously. Large containers make it possible to water and fertilize on a more relaxed schedule, but smaller pots can accommodate fine show specimens.

At Tanglewood in Lenox, Massachusetts, home of the Boston Symphony Orchestra in the summer, Superintendent James Kiley grows superb begonias in six-inch bulb pans, feeding them frequently with fish emulsion. These are seedling plants approximately six months old at the time of first flowering. At the Crane

These tuberous begonia cuttings are placed against the edge of the three-inch clay pot to provide extra aeration for their roots.





A bed of seedling begonias will brighten a semishaded area and provide cut flowers for floating in dishes or trays.

Estate in nearby Dalton, Carl Deame grows equally fine plants obtained from the same source, Koral Gardens in Pattersonville, New York; but Mr. Deame grows them in beds which have very nearly one hundred per cent sunshine. He also grows the pendulous or hanging basket begonias in redwood baskets and large bulb pans and enjoys a profusion of blooms rivaling that of plants grown under the ideal climate of the West Coast fog belt. At Koral Gardens, Bob Koral gets unbelievable blooms on many thousands of seedlings which he grows in a sterile mixture of peat-perlite-vermiculite in four-inch pots. The seedlings are nourished to perfection with a weekly feeding of diluted, carefully balanced, inorganic fertilizer. I have cited these experiences to indicate the wide range of cultural conditions which result in outstanding plants under the supervision of expert growers.

Until recently almost all tuberous begonias grown in the eastern United States were started from tubers. They had the advantage of being easily transported from the West Coast, England, Belgium, or wherever they are produced. However, tubers tend to lose their vigor with the passing of time, and even a new tuber appears to be a bottleneck in the orderly process of communication between the roots and the plant. Perhaps this is best demonstrated by planting a bed of tuber-grown plants and a bed of seedlings side by side. Tubers produce large plants quickly, but they are generally less satisfactory bedding plants than are seedlings of equally good strains. Seedlings purchased while they are small plants are relatively inexpensive, and they are frequently raised in the same manner as annuals with no attempt being made to produce tubers for the next year.

When an outstanding plant develops, the grower should make an effort to propagate it from cuttings, since only a cutting or tuber-division will produce another plant exactly like it. (Tuber-divisions are less desirable because of the loss of vigor associated with tubers.) Cuttings may be made from the individual plantlets which usually grow from the leaf axils near the base of a mature plant. A cutting three or four inches long is sufficient. Vermiculite, perlite, or coarse sand may be used as the rooting medium; but an even better

material for begonias and most other cuttings is the combination of two or three parts of ⅛″ to ¼″ expanded shale aggregate (available at most concrete plants) with one part of vermiculite. This material has perfect drainage, sufficient absorption, and enough stability to hold the cutting erect until rooted. The entire cutting should be dipped in a solution of fungicide, such as "Ferbam," since it is susceptible to rotting under the humid conditions required for rooting; and the base of the cutting should be dipped in a rooting hormone to hasten the process.

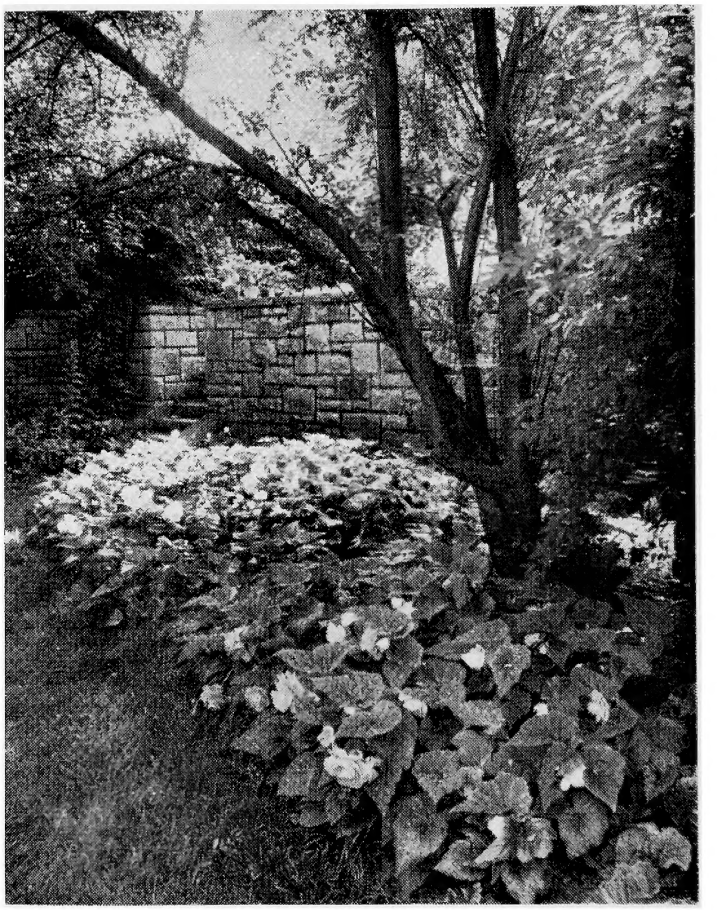
An English grower, Alan Langdon, suggests putting the rooting medium in a clean, three-inch, clay pot and inserting the cutting at the edge of the pot in contact with the clay. This permits additional air to pass through the porous clay and augment that which finds its way through the rooting medium. If the pot is placed in light shade and provided with a glass or plastic enclosure to increase the humidity, rooting should take place in about five weeks. Tip-cuttings may take a bit longer. A number of pots may be placed in a tray and watered from the bottom. Plants will bloom in three or four months from cuttings.

Insects rarely bother begonias. Thrips, cyclamen mites, and aphids have been known to attack them, but this is most unusual and an appropriate spray will quickly eliminate the pests.

Of the diseases only powdery mildew is ordinarily serious. Most gardeners have seen mildew on roses or phlox and will easily recognize it on tuberous begonias. Its effect may be disastrous, and usually will be if it occurs and nothing is done to eliminate it. There are, however, excellent specific remedies for mildew, including "Mildex" (also known as "Karathane") and "Actidione." These readily available fungicides will wipe out mildew in its incipiency or even check a general invasion, if it has been allowed to reach such proportions. In gardens where mildew is known to occur, it will pay to keep a small spray bottle handy so that the first telltale white patches can be treated. Often no more drastic measures need be taken. Sulphur is a reasonably good preventive but will not eradicate mildew once it appears.

Begonias form tubers in the short days of the fall. Whether grown from seedlings, cuttings, or tubers it is important that they be kept growing as late as possible, if the tubers are to be saved for the following year. Protection from the first frosts pays big dividends. This can be accomplished by covering or by moving the plants to a protected area. When the plant finally dies down, the stem should be permitted to part naturally from the tuber. The tuber is then cleaned and stored in a cool place for the several months of dormancy before it begins to sprout. Plastic bags make suitable containers, once the tubers are thoroughly dried.

Cool summers will always produce finer tuberous begonias than hot summers. Hot days are less damaging than hot nights. Unseasonably high temperature may discourage blooms for several weeks, but a return to night temperatures in the 50°-70° range will soon be followed by a fresh burst of color. Those who have seen tuberous begonias growing in the California fog belt or in cool, moist climates such as that of Vancouver, Banff, or the mountains of upper New York State or New England, know what can be done with almost no care where conditions are ideal. However, very fine plants may be grown in many less favorable areas, provided the grower understands the needs of these begonias and cares enough to make them comfortable. The extra vigor of seedlings makes them especially valuable for plantings in less than ideal areas, and even under very good conditions they are generally superior for bedding purposes.



A bed of tuberous seedling begonias in the author's garden in the old stockade area of Schenectady, New York. The photograph was taken in June as the plants began to bud and bloom after their roots had been established in the cool, moist weather.

. . What impulse, other than obvious hunger, led man first to turn the soil, fence in his patch, plant out the flowers and shrubs and trees which delighted his eye, and then at evening rest from his labors . . . to drink in the perfumes and breathe the peace that comes with the dusk?

. . . the Story of Gardening . . . reaches vast distances . . . and into the lives of ancient peoples in many lands. Passing along it we see all forms of gardens emerge, for even the primitive gardens contain germs of our own, and the seed of many a plant flowering in ours today was first sown countless generations ago. Along this road we meet a motley host of men and women, all intent on the same gardening purposes—kings and soldiers and mariners, scientists, explorers, artists, doctors, architects, priests and nuns, humble peasants and lordly rulers . . . Richardson Wright: *The Story of Gardening* (Dodd, Mead & Company, 1934)

MULCHING - A BOON TO GARDENERS

By HOMER L. JACOBS

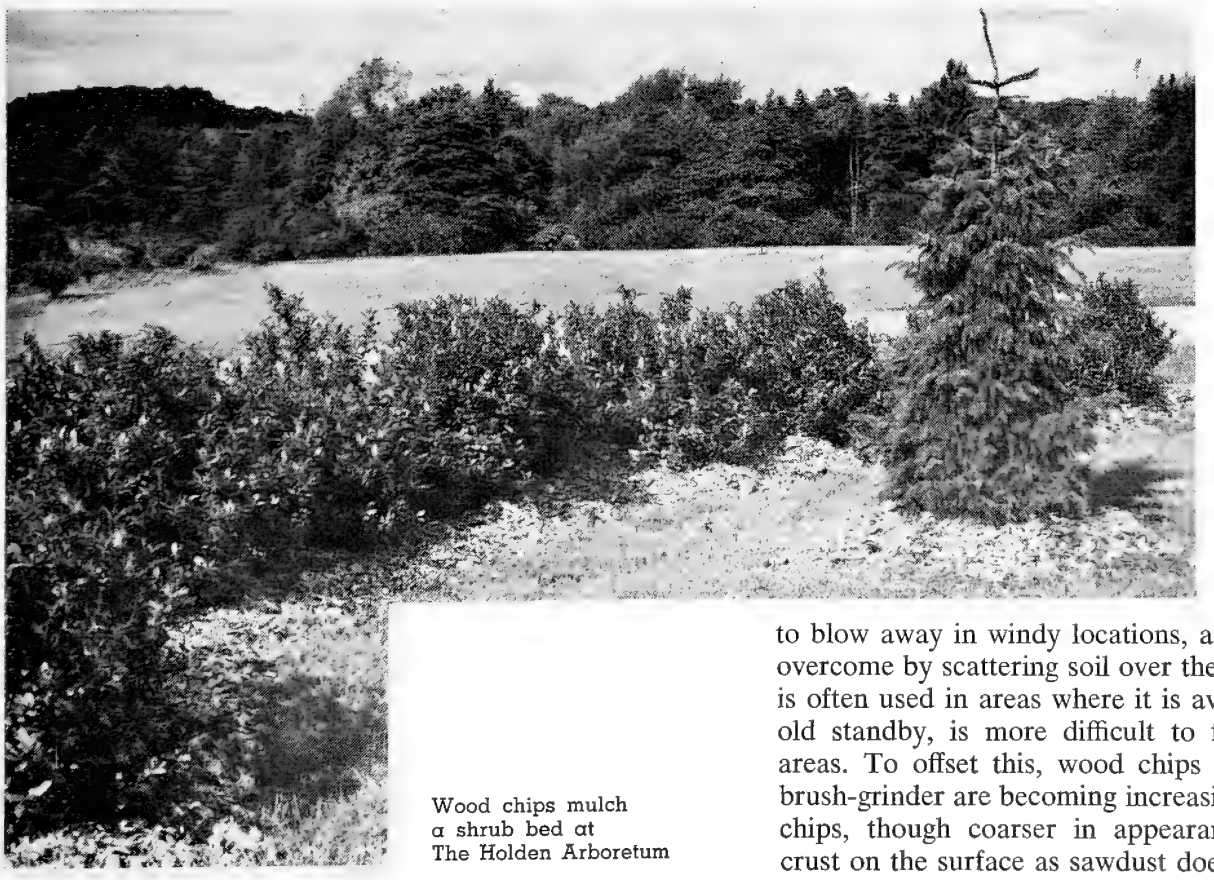
Mr. Jacobs is Consulting Arborist of The Holden Arboretum, Mentor, Ohio.

A MULCH, though simply a layer of some kind of material over the soil, serves some of the soil-improving purposes of more laborious cultivating operations. It prevents compaction of the surface, which occurs during rainfall on bare soil. Thus water infiltrates more readily without the repeated stirring necessary to keep the surface broken up and receptive to water. While mulches do not eliminate the weed problem, they lessen it and weeds which do grow in them are easy to pull. Most mulching materials are organic—vegetable or animal—in origin. As they break down through decay, they release nutrients which are carried to some depth by rainfall. Earthworms thrive in the humus formed by the decaying layer and contribute to better aeration and the resulting better root growth. In this way mulches improve both fertility and physical condition of the soil, as the mineral and organic components mingle in the surface layers.

Mulches are more effective than cultivation in controlling soil temperature. For example, when transplanting trees and shrubs in early fall, a heavy mulch can be used to blanket in the summer heat, keeping the soil warm and encouraging root growth when air temperature is dropping and the top of the tree is going dormant. In the spring the mulch can be removed and the soil allowed to warm up as air temperatures rise, again keeping root growth in step with the opening leaves, and their increasing demands for moisture and nutrients. By midsummer the mulch should be replaced. This will prevent undesirably high soil temperature in the surface layer, where root activity should be greatest to take advantage of light rains which may penetrate only an inch or two.

Whatever your garden interests may be, you can make use of mulches to some extent. The shrub border, the perennial bed, or the root area of large trees may be kept permanently mulched. The vegetable garden and the bed of annual flowers likewise benefit from mulches. As the thickness of the permanent mulch lessens by decay, more material should be added. That which remains at the end of summer in the vegetable garden can be removed to the compost pile or spaded under to form humus in the deeper layers.

Gardeners have a wide variety of mulching materials to choose from. Availability, cost, personal liking, and the areas in which they are to be used will influence your selection. Where appearance is not important, such coarse material as corn stalks may be used; even weeds at times serve the purpose, though you should consider the possibility of introducing seeds of difficult-to-eradicate weeds by this practice. Straw from wheat, oats, and rye is standard material. Straw has a tendency to blow away in windy locations, a fault which may be overcome by scattering soil over the top. Salt marsh hay is often used in areas where it is available. Sawdust, an old standby, is more difficult to find today in urban areas. To offset this, wood chips from the tree-man's brush-grinder are becoming increasingly plentiful. Wood chips, though coarser in appearance, do not form a crust on the surface as sawdust does; consequently, wa-



Wood chips mulch a shrub bed at The Holden Arboretum

Wood chips serve as a mulch around shrub specimens at The Holden Arboretum.

ter penetrates more readily and breaking of a crust is unnecessary.

Pine needles, leaves from deciduous trees, and grass clippings from your own or nearby property can be obtained with little labor and should be used at every opportunity. Another by-product which can sometimes be secured locally is spent hops from a brewery. Hops, like some peats from locally worked bogs, may be so high in moisture-content that the cost of hauling makes them more expensive than they seem to be. Ground corncobs form a good mulch and can often be obtained in quantity at low cost.

Fortunately garden supply stores have such a variety of processed and packaged mulch materials that you need not depend on chance or on locally produced by-products. Some of these stores include materials mentioned above, such as pine needles, ground corncobs, and even packaged wood chips.

Because it is clean, neat in appearance, and readily available, peat moss—sphagnum moss peat—is unsurpassed as a mulch material. It does have a tendency to form a crust which can be lessened by cultivating or scattering soil on the surface. It is relatively dry in the bale and requires liberal amounts of water to wet it thoroughly. Consequently, it should be applied in a thin layer—an inch or two—and added to from time to time. It does not decay as rapidly as some other organic products.

Peanut hulls, several kinds of shredded bark, dried animal manures, and bagasse, which is dried sugar-cane pulp, are other materials available at garden supply stores or which they can secure for you. Bagasse is said to be, for some reason, unusually effective in suppressing weeds. Buckwheat and cocoa-bean hulls form very attractive mulches for the dooryard or other areas where neatness is important. For a time after application cocoa-bean hulls retain their chocolate odor, which some gardeners find pleasing, others not so. Seaweed, tobacco stems, and cotton burs should be added to the list of organic mulching products.

Fine gravel and crushed stone are sometimes used as mulches. Since they do not decay, they provide no nutrients for plants. However, a layer of stone does not form a hospitable surface for weeds to grow in, as a layer of wood chips or most other organic materials do. And, of course, it does not have to be added to to maintain its thickness.

One other product, quite different from the older, more commonly used materials mentioned above, has some unique qualities which merit a more detailed discussion. This is black polythylene plastic which can be bought in sheets of various thicknesses and in rolls of various widths and lengths. These sheets or strips are laid down between rows of plants or, with care, can be fitted closely around the stems of irregularly spaced plants in beds or borders. For newly transplanted trees or shrubs, a sheet three or four feet square can be split down one side to the center and fitted around the tree trunk; the entire sheet can then be pinned down or held in place with upturned sod or a ridge of soil piled along the edges.

While one may wonder how water gets to the plant roots under plastic mulch, it evidently works in at the slits or along the edges where two sheets are joined. Water penetration can be helped by making small punctures through the film in depressions where water collects. At any rate, experience and research have shown that plastic-mulched trees and other plants grow bet-

Polyethylene plastic sheets are used as mulch around individual shrubs at The Holden Arboretum. These sheets are still serviceable at the end of two growing seasons.

ter than similar plants left unmulched.

At The Holden Arboretum we covered the soil along each side of a row of newly planted white pine seedlings with black polyethylene. Throughout the first growing season, this row visibly indicated better growth than either of two rows of unmulched trees alongside. At the end of the second growing season, the year's growth was measured. The measurements showed that the trees in the plastic-mulched row had much greater average growth than the trees in the two unmulched rows.

To the home owner a decided advantage of plastic sheets over most other mulches is the much greater—almost complete—suppression of weeds. For vegetables or annuals, where a year-round mulch is not needed, sheets one and one half millimeter thick are often used. (A millimeter is one one-thousandth of an inch). Over the roots of trees or shrubs, thicker sheets, up to six mm., last longer and keep the weeds under better control. If you find the black sheets objectionable in appearance, you can cover them with your favorite mulch material. In this way your garden will have the advantage of greater weed elimination from using the plastic and the appearance you prefer.

I have mentioned the fact that water-repelling crusts form on the surfaces of some mulches. Other features of mulching materials should be mentioned. Fungi and bacteria which break down organic materials low in nitrogen need this element in such quantity that they may rob the surface soil of nitrogen to the detriment of the plants. Such low-nitrogen products are sawdust, wood chips, cereal straw, and hay. When these are used, nitrogen-carrying fertilizers should be applied liberally to the fresh mulches. On the other hand some materials, among them tobacco stems, cocoa-bean hulls, and dried manures, contain enough nitrogen to supply the needs of the agencies of decay. For these the addition of fertilizers would be wasteful and might even be harmful.

Many mulches, when dry, will burn—some more readily than others. The possibility of fire, where they are used, should be considered. Spent hops are said to be somewhat fire-resistant.

Mulches also attract rodents by furnishing shelter and some, such as corncobs, wheat straw, and cotton burs, contain occasional seeds which supply food for mice. However weeds, grassy sod, and even snow furnishes cover beneath which mice build runways to reach bulbs and plant roots on which they feed during winter. For this reason, mulches should not be avoided because of the possibility of encouraging mice. Mice, like many other pests, can be controlled.

Mulches should be used as freely as cost and availability permit and should be repeated when necessary. The advantages more than outweigh any disadvantages.

A PORTRAIT OF JOHN BARTRAM IDENTIFIED

By ROBERT G. STEWART

Mr. Stewart is Curator of the National Portrait Gallery, Smithsonian Institution, Washington, D. C.

SINCE THE MIDDLE of the nineteenth century a controversy has existed as to whether there ever was a portrait painted from life of the first native-born American botanist, John Bartram (March 23, 1699-September 22, 1777).[1]

A portrait has recently come to light which appears to resolve the question. Although an adequate provenance of the painting is lacking, the iconography in the painting and the time and the artist who painted it all fit together in a fascinating combination of artistic and historic detective work. The painting is a recent acquisition of the National Portrait Gallery and was exhibited publicly for the first time in the fall of 1966.

By chance I met a Washington collector who named the various portraits in his collection, including the name of John Bartram. When subsequent investigation showed the controversy over an authentic likeness, the owner was persuaded to bring the painting to the Gallery for further study, and finally it was acquired for the permanent collection.

The owner had purchased the painting from a dealer in Alexandria, Virginia, who in turn had purchased it from an estate in Towson, Maryland. In subsequent correspondence with the heirs of the estate they were, although most interested and cooperative, unaware of the existence of the painting or any family relationship with the Bartram's or their associates.

With the abrupt and discouraging end in search of the provenance or history of its ownership, it was necessary to turn to the painting itself. The owner bought the portrait with the attribution as by "Hesselius." Whether it was Gustavus Hesselius (1682-1775), the immigrant from Sweden who came to America in 1711 and was active until his death, or his son John Hesselius (1728-1778) was unknown.

After examination of the known works of these men and study of what is known of their lives, I concluded that it was not by either of these two men, but by the artist John Wollaston (c. 1710 - c. 1767). Even though Wollaston gave instruction to the younger Hesselius and John Hesselius's painting shows his influence, the Bartram portrait is clearly by the master and not by the pupil.

The painting is unsigned and undated. Its dimensions are 35¼″ x 27¼″ and have been cut down in size. The gentleman is portrayed half-length, seated, with the

body turned to the left. The face is turned three-fourths to the front, the left arm rests on a table top, and the elegantly postured hand points to a large, yellowish green pear. The subject is dressed in a white wig with curls, now much abraded, which are painted with great technical skill. He wears a flowing, lightly fringed Steinkirk jabot which is tucked jauntily into the fourth buttonhole of his coat. The coat is a dull olive-green with no collar and exaggerated sleeve cuffs. It is decorated with green buttons and is open, revealing a white shirt which lacks the cuff ruffle characteristic of the times.

The brown background is characteristically Wollaston as are the high forehead, the almond eyes, the postured hand, and the pose with the hand resting on a table. The subdued greens and browns are also Wollaston characteristics. He seems to have sketched his subjects in a brown-ochre paint and then laid on his color in glazes. As a consequence of abrasion, the tendency for oil paint as it ages to bleed through paint surfaces above it, and perhaps by the artist's intent, the pear, the hand, the coat, and the face appear to be outlined in brown. This is another of the attributes of Wollaston's portraits.

His gaze directed intently at, but slightly above the viewer gives Bartram a thoughftul, almost religious sense of natural simplicity. In this sense, the painting can be considered one of Wollaston's finest in that it captures a quality of personality characteristic of Bartram difficult to record in pigments, words, or photographs.

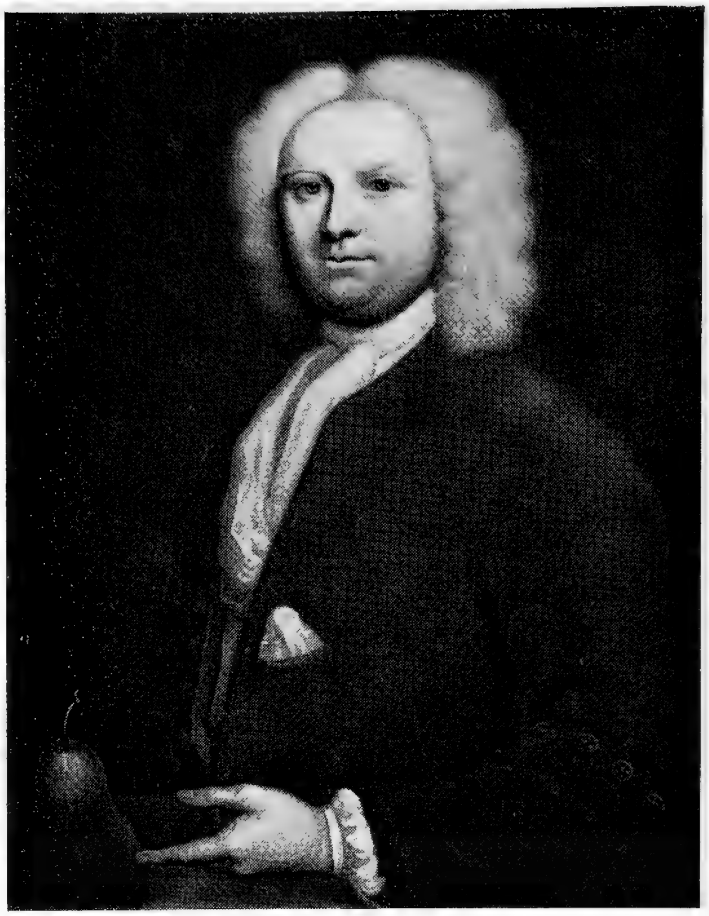
John Bartram's grandfather, a Quaker, had left England and settled in the Province of Pennsylvania in 1682. John Bartram was a birthright Friend and remained a member of this group until he was "read out of meeting" in 1758 for his Unitarian views.[2]

Bartram, according to his son's account, had been interested in botany since he was a boy of ten.[3] He was always a lover of plants which he enjoyed gathering and distributing. In 1728 he purchased a plot of land at Kingsessing, then three miles from Philadelphia on the banks of the Schuylkill. This is now known as Bartram's Garden and is part of the Philadelphia Park System. Here he began what were probably the first experiments in hybridizing in America.

Sometime after this, probably in 1733[4], a friend sent some of Bartram's specimens to Peter Collinson, mercer, of London. This began a friendship by correspondence which was to continue for thirty-five years, although the two men never met.

Peter Collinson was a Fellow of the Royal Society of Antiquaries. Through his business he was acquainted with everyone of note in the American Colonies, from New England to the Carolinas. He was an intimate of Cadwallader Colden, Dr. Benjamin Franklin, and a friend of Thomas Penn, Proprietary of the Province of Pennsylvania.

Collinson was also in contact with several noblemen, including Lord Petre, the Earl of Jersey, and the Dukes of Richmond, Norfolk, and Bedford. It was undoubtedly through their influence that in 1765 George III



The portrait of John Bartram that has recently been acquired by the National Portrait Gallery for the Smithsonian Institution, Washingon, D. C.

appointed Bartram botanist for Florida Territory at a salary of £50 per annum.[5]

These noblemen were all interested in botany and in building collections at their country seats. Collinson suggested a business venture, and Bartram agreed to send boxes containing 105 specimens of American plants at a fixed price of five guineas each box. One of the first subscribers was Lord Petre in 1736. Among others who took boxes were the Marquis of Kildare, Thomas Penn, Capel Hanbury, the Prince of Wales, Sir John Mordaunt, and Dr. Franklin.

Robert Edward, eighth Baron Petre of Writtle, (1713-1742), was to become, for all too short a time, one of Bartram's most important patrons. He purchased from Bartram, through Collinson, quantities of seeds and specimen plants for his estates, Thorndon and Ingatestone Hall in Essex. Since his father had died of smallpox three months before he was born, Lord Petre enjoyed an income from vast land holdings in Essex, Kent, Suffolk, Devon, Somerset and Gloucestershire.

In addition, he had married on May 2, 1732, Anna Maria Barbara Radcliffe (1716-1764), the daughter of the third Earl of Derwenter.[6] The Earl had been executed for his support of James Stuart's attempt to take the throne in 1715, and Lady Ann was the heiress of the Derwenter estates because her brother had died the winter before.

When Lord Petre's mother remarried in 1733, the young couple occupied Thorndon Hall. Lord Petre en-

gaged Giacomo Leone, a Venetian architect, to design changes in the Hall and also in the gardens and park.

In 1736 Lord Petre introduced the first plantings from Bartram's shipment. He continued to introduce North American plants and also seedlings shipped by Bartram through Collinson.

Sometime in 1738 Lady Petre had sent, as a gift to her husband's protégé, some pear seeds for his garden. Bartram planted this near his house, and the seedling Petre pear tree began to grow. In a letter of September 12, 1739, Collinson suggested that Bartram, as a return gift, send a hummingbird's nest with eggs, no doubt considering this a proper offering to the lady.

Unfortunately, Lord Petre died on July 2, 1742, of smallpox, leaving Lady Petre a widow, twenty-six years of age, with four children. She was named sole executrix of the Petre estate, which included the 219,925 plants in the nurseries. Fortunately, she was able to dispose of these to other Bartram customers; namely, the Dukes of Richmond, Bedford, and Argyle, the Earl of Lincoln, and Lord Bute. During the rest of her life Lady Petre was to keep in touch with Bartram. Moreover, Collinson later was able to interest Lord Petre's son, the new Lord Petre, in ordering plants.

According to Robert Carr who managed the garden, (he married Ann Bartram, a granddaughter of John) Mr. Bartram had told him that the Petre pear tree was about twenty years old before it produced and narrowly escaped being cut down as barren.[7]

Petre pear, taken from Hoffy's *North American Pomologist* by William D. Brinkle, editor, and reproduced here by courtesy of the National Portrait Gallery, Smithsonian Institution, Washington, D. C.

Anna Marie Radcliffe, daughter of the third Earl of Derwenter and wife of Lord Petre. Reproduced by permission of the Rt. Hon. Lord Petre: photographed by Essex County Council.

In October, 1763, Bartram wrote to Collinson, "The pear raised from seed hath borne a number of the finest relished fruit, I think a better is not in the world."

On January 1, 1764, Collinson answered: "It has been my patience to wait but my pleasure to hear of the delicious pear raised from Lady Petre's seed, but the dear lady has gone to rest."

And now turning to the life of the artist — John Wollaston was painting in the United States off and on from 1749 until 1767. He painted in New York from 1749 until 1752; in Maryland in 1753; in Virginia from 1755 through 1757; and briefly in 1758 in Philadelphia. He then left for India having been appointed a "writer" for the Bengal establishment of the British East India Company. By 1760 he was a magistrate in a court in Calcutta. Nothing is again certain of his career until January, 1767, when he was painting in Charleston, South Carolina. On May 31, 1767, he sailed for London on the ship "Portland."[8]

Charles Willson Peale recorded that he was in London when Wollaston returned from India and reported that he moved to Bath, but thus far no records have been located to show any further events in his life.[9]

It is singularly significant that Wollaston was painting in Philadelphia in 1758, which is very likely the year that the Lady Petre pear tree first bore fruit. What better way to compliment a patron than to have a gift presented by him painted into his portrait. The portrait or a copy of it may have been intended as a gift either to Lady Petre or to Peter Collinson.

An interesting sidelight is that Cadwallader Colden (1688-1776), the eminent loyalist, philosopher, botan-

ist, and scientist, was a close associate of John Bartram. Mr. and Mrs. Colden sat for Wollaston presumably when he was in New York between 1749 and 1752. These portraits are now in the collection of the Metropolitan Museum of New York.[10]

Colden introduced the Linnaean system of botanical classification in America shortly after its publication in Europe. He lived in Philadelphia from 1710 to 1715. Considering the young Bartram's interest in botany at the same time, it seems certain that they became acquainted during this period and remained friends during their lives. John Bartram visited Colden at his home on the Hudson River in the fall of 1742.[11] Colden's daughter Jane (1724-1766) was the first women in the New World to be distinguished as a botanist.[12]

With such a close relationship between the two families, it is likely that Colden recommended Wollaston as a painter to Bartram. What is more to the point, Colden may have commissioned the portrait for himself. He was a wealthy man with an interest in all fields of learning which encompassed the fine arts. The request for a portrait of a friend was common during the eighteenth century among the class which could afford it.

It is unfortunate that the provenance of this painting is lost. The late Francis D. West, a Bartram descendant, stated in his review of Josephine Herbst's book on John Bartram, *New Green World,*[13] that the illustration used as a portrait was not Bartram, "since no likeness of him has ever existed."

Mr. West appears to have known of a statement of John Bartram's son William to the effect that no portrait of his father had existed. However, I have been unable to find this statement by William Bartram. At the time the portrait was painted, William had been residing more than a year with Mr. Child, the Philadelphia merchant to whom he had been apprenticed. Furthermore, the painting never hung in the Bartram house and may never have been seen by William.

Given that the subject is pointing to a pear, there is only the circumstantial evidence of the year when the Lady Petre pear first bore fruit, coupled with the fact that John Wollaston was in Philadelphia in the same year, to prove that we are looking at a likeness of John Bartram whom Linnaeus considered "the greatest contemporary natural botanist in the world."[14]

1. A drawing purporting to be Bartram appeared in *The Garden Monthly,* September, 1860. This is incorrect as to costume for the period. From the fragment of a white flower thrust into the bosom, this is possibly a poorly remembered description of Charles Willson Peale's portrait of William Bartram painted in 1808 and now in the collection at Independence Hall. The portrait at John Bartram High School in Philadelphia by Albert Hampson is based on the 1860 drawing.

   Another portrait, belonging to the Pennsylvania Horticultural Society, turned up in a New York secondhand shop in December, 1922. On the back was written "Portrain of John Bartram of Darby, died 1777. C. W. Peale, Artist, Property of Isaac Bartram, 1795." It was purchased by the late Mrs. Horatio Gates Lloyd and bequeathed to the Society. The portrait is certainly not by Charles Willson Peale, but without having examined anything but its photograph, I see no reason why it cannot represent the same subject as the Wollaston by another artist and painted much later in life.
2. Dictionary of American Biography, 1927. Charles Scribners and Sons, Vol. I, pp. 26-28.
3. Phila. Med. and Phys. Jour., Nov. 13, 1804.
4. Fox, Richard H.: Dr. John Fothergill and His Friends. 1919. London, MacMillan and Co., pp. 159-171.
5. Dictionary of American Biography, *op. cit.*
6. Prince, Winifred N., "John Bartram and Thorndon Park," The Garden Journal, Vol. 2: No. 5, pp. 141-152; No. 6, pp. 189-191.
7. West, Francis D., "The Lady Petre Pear Tree," The Garden Journal, Vol. 8: No. 1, pp. 6, 21.
8. Groce, George C., "John Wollaston (Fl. 1736-1767): A Cosmopolitan Painter in the British Colonies," The Art Quarterly, Vol. 15: No. 2, pp. 132-149.
9. *Ibid.*
10. Gardner, A. E., and S. P. Feld: American Paintings—A Catalogue of the Collection of the Metropolitan Museum of Art, Vol. I, pp. 9-11. 1965.
11. Prince, *op. cit.*
12. Dictionary of American Biography, Vol. II, pp. 288-289.
13. West, Francis D., rvw. of The New Green World by Josephine Herbst, Penn. Mag. of Hist. and Biog., Vol. LXXVII, No. 4. 1954.
14. Dictionary of American Biography, Vol. I, pp. 26-28.

Season of mists and mellow fruitfulness!
Close bosom-friend of the maturing sun;
Conspiring with him how to load and bless
With fruit the vines that round the thatch-eaves run;
To bend with apples the moss'd cottage trees
And fill all fruit with ripeness of the core;
To swell the gourd and plump the hazel shells
With a sweet kernel; to set budding more,
And still more, later flowers for the bees,
Until they think warm days will never cease,
For summer has o'er brimmed their clammy cells.

Who hath not seen thee oft amid thy store?
Sometimes whoever seeks abroad may find
Thee sitting careless on a granary floor,
Thy hair soft-lifted by the winnowing wind,
Or on a half-reap'd furrow sound asleep,
Drowsed with the fume of poppies, while thy hook
Spares the next swath and all its twinèd flowers;
And sometimes like a gleaner thou dost keep
Steady thy laden head across a brook;
Or by a cider-press, with patient look,
Thou watchest the last oozings hours by hours.

Where are the songs of spring? Ay where are they?
John Keats

Above. The native western azalea, *Rhododendron occidentale.* Right: *Rhododendron macrophyllum,* common to the West Coast.

THE HISTORY OF RHODODENDRON POISONING

By DAVID G. LEACH

Mr. Leach, a serious student of the genus *Rhododendron* and the author of *Rhododendrons of the World,* spent two years intermittently in Istanbul, Dubrovnik, London, New York, Washington, Philadelphia, and Pittsburgh in research on the history of the toxicology of rhododendrons.

An abridgement of his manuscript will appear in Johnson and Johnson's *Profiles,* and it will be published in full in the quinquennial yearbook of the American Rhododendron Society.

PART II

In the long and venomous history of the pretty but pernicious rhododendron, its narcotic properties provided one note of comic relief. In 1768 Catherine the Great, a devoted student of human anatomy, employed Peter Simon Pallas as a naturalist on a six-year expedition to explore the empire to the frontiers of China. She subsequently underwrote the cost of publishing his *Flora Rossica* in 1784. It was extraordinarily handsome for its time, bound in royal red Morocco leather with Catherine's coat of arms, the imperial double eagle, emblazoned in gold on the cover. Graceful, sophisticated, colored drawings illustrated many of the plants described in Latin by Pallas, with Russian subtitles.

G. W. Steller, another botanist and explorer in the German colony which formed the scientific community in Russia in the eighteenth century, had edited the later volumes of J. G. Gmelin's *Flora Sibirica* after his death. Pallas described, in *Flora Rossica,* Steller's experience with a pet deer which ate about ten leaves of *R. chrysanthum.* "After a few minutes the animal began to beat the ground, to dash its head and to stagger. In a short time it fell on its knees, trying in vain to rise again, nor was it revived with milk, but overcome by a deep drunken sleep remained on the ground for several hours . . . and trembling from time to time in its sleep; however, after it awakened, it was as before—cheerful, nor did the rhododendron ever affect it again."

But Steller's servants on the expedition had seen the cheerful deer too, and thereafter he had an exasperating time keeping them sober. They were "intoxicated very often because of the pleasure of the boiled down drink of leaves." Steller probably did not know that the Armenians had, for centuries, added small quantities of honey made from the Pontic azalea *(R. luteum)* to alcoholic drinks to intensify their effect.

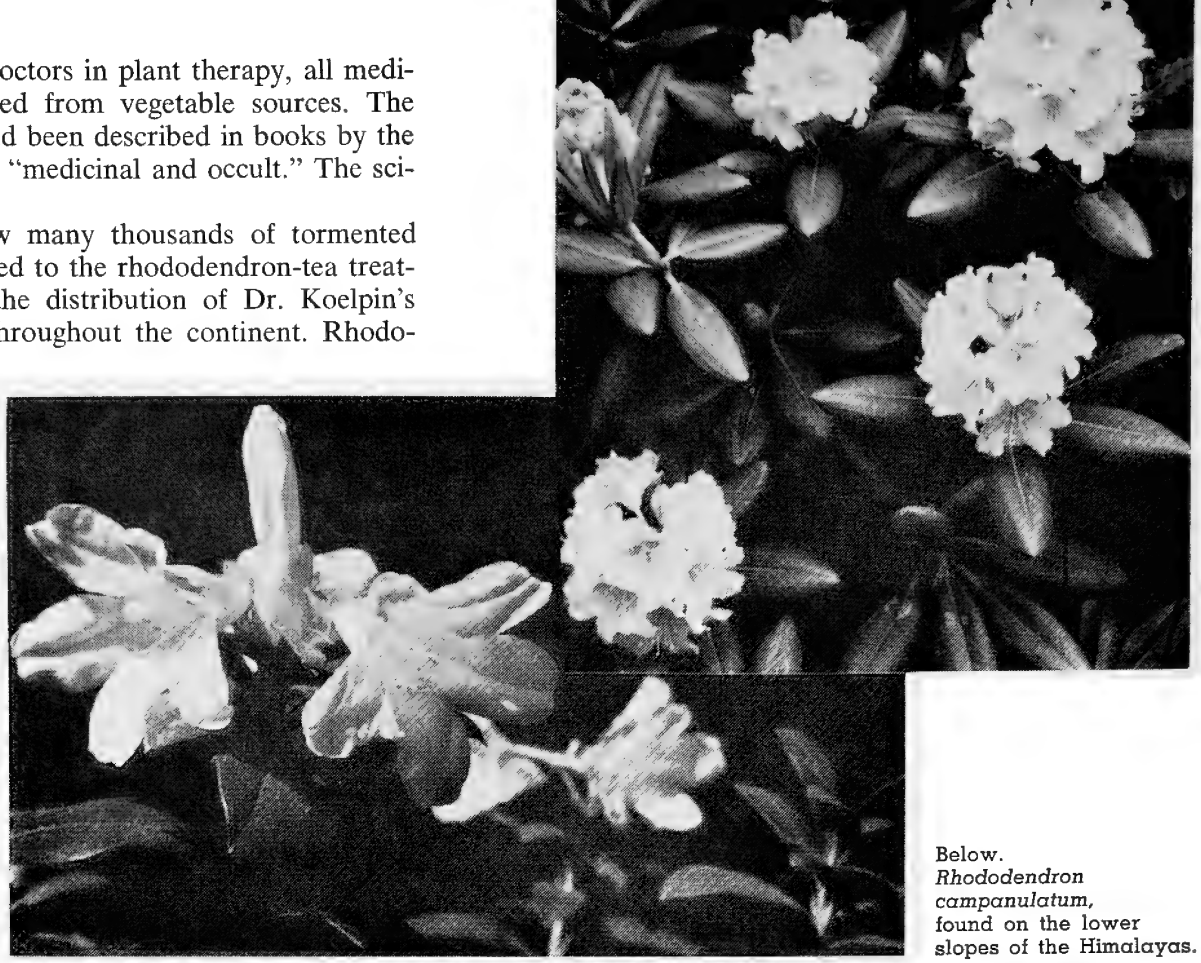
Dr. Steller later described, in his *Beschreibung von dem Lande Kamtschatka* (A Description of Kamtschatka, 1774) how the local wild deer on the Siberian peninsula after eating rhododendron leaves "became intoxicated, fell down and went to sleep. When the native people find an animal so affected, they tie its legs together until the effect is over and then kill and eat it. But if they kill it while the animal is sleeping or mad, anyone who eats the meat will have the same symptoms of madness."

Dr. Koelpin's book, in which he recommended a tea made from the leaves of the poisonous Siberian snowrose *(R. chrysanthum)* for the treatment of arthritis, had an almost hypnotic effect upon the doctors of Europe, eager as they were for any remedy which might aid their afflicted patients. Eerily, it somehow persuaded them to ignore the grisly side effects, which were dutifully documented, and diverted their attention to the reported cure, however tenuous the evidence for it.

The medical profession had not too long before struggled free from an arcane morass originating in sorcery and superstition. Within the century witches had been

as knowledgeable as doctors in plant therapy, all medicine then being derived from vegetable sources. The properties of plants had been described in books by the herbalist-physicians as "medicinal and occult." The science was yet to come.

No one knows how many thousands of tormented arthritics were subjected to the rhododendron-tea treatment as a result of the distribution of Dr. Koelpin's books to physicians throughout the continent. Rhododendron leaves were shortly included in the pharmacopoeia at Edinburgh. In 1793 Woodville remarked in his *Medical Botany* that they were "very generally employed in chronic rheumatism in various parts of Europe."



Upper right. *Rhododendron brachycarpum,* native to Japan and Korea.

Right. *Rhododendron ciliatum,* an Himalayan species.

Below. *Rhododendron campanulatum,* found on the lower slopes of the Himalayas.

Certainly the prostrating therapy traveled quickly across the Atlantic because Professor B. S. Barton in his *Collections,* a compendium of information on medically useful plants published in 1794, mentions ". . . the *Rhododendron chrysanthum,* which has lately acquited much reputation in the cure of chronic rheumatism." Jacob Bigelow, professor of Materia Medica at Harvard, published his *American Medical Botany* a few years later. In it he refers to the familiar rosebay rhododendron of the Northeast, *R. maximum,* as possessing astringent properties and, to prove his belief that it was not poisonous, described how he "swallowed a green leaf of the middle size, so large that it required some resolution to masticate so unpalatable a morsel, but have found no ill effect whatever to result from it."

The account of the determined, black-garbed New England professor browsing soberly at his desk on a rhododendron leaf evokes an entertaining mental image. But the brave Dr. Bigelow was wrong—a single leaf of the American rosebay would have produced no illness. As late as 1905 a British author, William Watson, wrote, "A decoction of *Rhododendron chrysanthum* . . . is now used in some European countries . . . in the treatment of rheumatism and other affections of the joints and muscles . . . and in the United States a decoction of the leaves of *R. maximum* is occasionally used for the same purpose." Dr. Koelpin's chamber of horrors had expanded into a corridor of suffering which extended for a hundred and fifteen years.

Professor Pallas, unhappily, furthered the legend of relief from arthritis by the drinking of rhododendron tea. In his beautiful book he wrote, ". . . the medicinal value of this Rhododendron has become especially famous. I have concluded that its use is harmless, because the inhabitants of the woods of Tatarus, near the ridge of Sajanense, are accustomed to use the ripened leaves continually after the manner of tea and praise them for assisting in health. I have observed that a great many inhabitants of Siberia, having been cured from very serious gouty ailments—rheumatism, nay even venereal diseases, by a boiled-down drink of the leaves—have

readily returned to this excellent domestic remedy.

"I . . . when the opportunity was given, not only have proved its great usefulness, but also when an abundance of the rhododendron [*R. chrysanthum*] leaves had been brought from eastern Siberia, gave the opportunity to my old friend Dr. Koelpin of confirming the values of this shrub by repeated experiments, nor did I stop until it might always be on hand in the future for the relief of sick people. It is now sold by public pharmacists everywhere for the price of a ruble a pound.

"Dr. Koelpin has explained the use and effects of Rhododendron in his own work. It confirmed to a very great extent what I previously reported: he explained that it is very beneficial for rheumatism and especially for chronic arthritis; that it also helps the pain of gout, even of the plague itself." Pallas overlooked Dr. Koelpin's report that the tea, held in the mouth, relieved toothache as well.

On August 15, 1796, Athony Hove, a Polish-born gardener enroute to Bombay to obtain seeds of cotton for the West Indian colonies, at the direction of the Royal Botanic Gardens at Kew, sent from Odessa a letter which is still in the Bank's correspondence at the famous botanic garden near London. In it he described the Pontic azalea notorious in antiquity and continued, "The inhabitants use the leafs and buds as Tea, especially after being fatigued with labour, they refresh themself with great and speedy surprise, it stupifyes them for an hour or so, and throws them in to a sleep, on awakening they resume their work without the least appearance of bad effects.

"In Chronik Rheumatik disorders they use it with greater success of which I was not only an eye witness but have been self cured of a violent Rheumatik pain in Arms, and thighs which I had some time contracted by sleeping on the swampy grounds, and could not get rid of it until I dranck of this decoction.

"On drinking of it an English pint, I found myself quite restored in less than twenty-four hours, during the process I found myself in a kind of anxiety and great uneasiness, which lasted above an hour, and then it abated gradually, afterwards I fell asleep for two hours, on awacking I found myself in an abundant perspiration and quite recovered of the pain, much strengthened without the least symptom of headack.

"They likewise, use it in Syphylitic cases, with what success I had not so much opportunity as yet to determine, but as the disease is not very common amongst them, although they are frequently visited by the Russian Armys, I am led to credit their relation."

Two years later Hove sent a plant to Watson's Nursery in Islington which shortly flowered in a greenhouse, and at last the dangerous *R. luteum* was seen in bloom in the western world.

The use of the Pontic azalea in the Ukraine and of the evergreen *R. chrysanthum* in eastern Siberia, four thousand miles distant, to ease rheumatic pain seems an unlikely coincidence. But the buds and leaves of the alpine rose, *R. ferrugineum,* were gathered in the Alps and used for the same purpose in Italy. The older generation in Japan, even today, makes a tea from *R. brachycarpum* which grows there. And dried leaves have been commonly sold for centuries in Chinese drug shops for the treatment of circulatory disorders, a remarkable prescience in view of later developments. The rolled-up leaves of another species are smoked for the relief of asthma. In China rhododendron leaves are used to adulterate conventional tea. Snuff is made in India from the powdered leaves of *R. campanulatum* which is common on the lower slopes of the Himalayas.

The world-wide use of rhododendrons for medicinal purposes and as an intoxicant goes back thousands of years, but it was not fully explained until Dr. S. W. Hardikar of the Pharmacological Laboratory at the University of Edinburgh published, in 1921, an exhaustive study of rhododendron poisoning. He reported that the active agent causes "a narcotic action upon the higher centers of the brain." Whether intoxicant, painkiller, or deadly poison depends upon the size of the dose.

Dr. Hardikar began his study because "Some time ago sheep in the neighborhood were reported to have shown symptoms of poisoning from eating rhododendron leaves. . ." In his published paper is a terse summary of the effect of injecting .28 milligrams of the rhododendron extract into a female rabbit in his laboratory. Within eighteen minutes its respiration declined from 180 to 36 per minute. An hour and twenty minutes later, the animal was unconscious, and it was dead by the following morning.

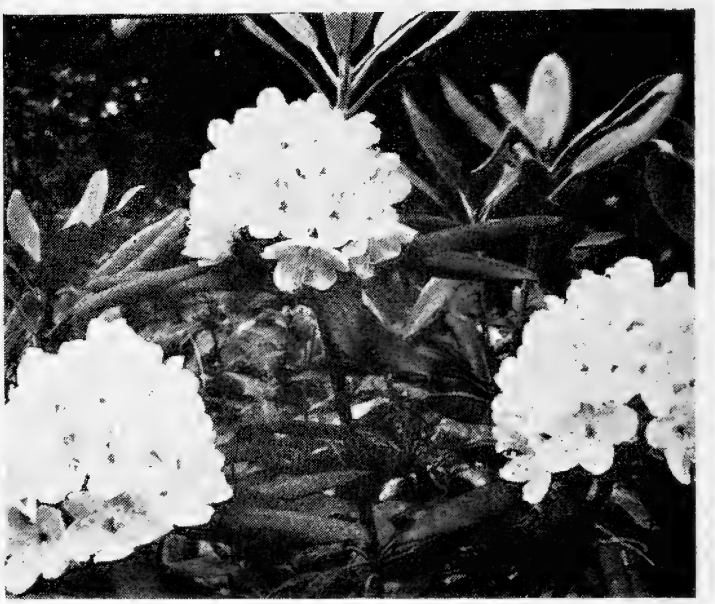
Domesticated animals have been scourged by rhododendrons from prehistoric times. Those who wrote of their direct effect upon man also reported on the indirect effect through the loss of livestock by poisoning.

An issue of *The Botanical Magazine* in 1799 quotes the same Prof. Pallas who extolled a tea made from the Siberian *R. chrysanthum* as a cure for arthritis: ". . . goats, kine and sheep on eating its leaves have been poisoned thereby." In his description of the Pontic azalea *(R. luteum),* Pallas had written, "The leaves, which smell pleasant and are bitter at first, when the pastures are not yet green, are often eaten by goats with an intoxicating effect; even the intoxicated cattle and sheep die thereupon." His contemporary colleague G. S. Steller, across the continent at the Pacific limit of Asia, saw "a goat, which, by eating . . . the plant, was seized in a few minutes with tremblings, sopor, etc." related Woodville in his *Medical Botany* of 1792. Forty-six years later John Lindley published his *Flora Medica* in London and included in the directions for medicinal use of the Siberian rhododendron a comment on the Pontic azalea that "goats which browse on the leaves . . . suffer in consequence, and that . . . cattle and sheep perish."

In mid century Sir Joseph Hooker led a plant hunting expedition to Sikkim which resulted in the publication in 1849 of *Rhododendrons of the Sikkim Himalaya.* He described one of his discoveries, the beautiful bell-flowered cinnabar rhododendron *(R. cinnabarinum)* as being "universally considered poisonous to cattle and goats." J. G. Millais produced a notable volume on rhododendrons in 1917 in which he commented that

The Catawba rhododendron, *R. catawbiense*, in the mountains of North Carolina.

The familiar rosebay of the Northeast, *Rhododendron maximum.*



". . . the leaves of many species are poisonous to animals. *R. ferrugineum* causes losses in the Alps; sheep, goats and cattle are poisoned and sometimes killed by *R. ponticum*." He describes the near-fatal effect on a baker's horse which had nibbled two shoots on *R. ciliatum* "in a gentleman's drive." "In England," wrote Watson in 1905, "Rhododendrons are not usually eaten by animals, not even by rabbits and hares, but when they have been eaten by accident their effect has been noxious."

Half a world away the sole species which is found in Afghanistan, *(R. afghanicum),* is notoriously virulent. It has been a curse of shepherds for centuries. In 1965 an explorer in New Guinea, Michael Black, wrote of an orange-flowered rhododendron common in the Central Highlands, "It has a reputation through the country of being exceedingly poisonous to livestock, and I was told of three mules which had recently expired after eating small quantities of the foliage."

In the United States, Chestnut's *Preliminary Catalogue of Plants Poisonous to Stock* lists the common West Coast rhododendron *(R. macrophyllum)* as being injurious to sheep in Oregon, and the only western native azalea *(R. occidentate)* is indicated by Professor Pommel of Iowa State College as being toxic to livestock in California. In the East, the famous Catawba rhododendron *(R. catawbiense)* of the North Carolina mountains is equally guilty. So the toll of domestic animals by the deceptively beautiful rhododendron has been world-wide and all but unknown to millions of home owners who treasure them in their gardens.

But perhaps the strangest application of the rhododendron to animals was proposed by a Japanese nurseryman in the Royal Horticultural Society's *Lily Yearbook for 1964*. He suggested that lilies would not be devoured if they were planted among rhododendrons, thus turning to advantage the usual aversion of animals to the shrub.

The discovery of the effect of digitalis upon the heart stimulated a great wave of scientific investigations into medicinal plants in the latter half of the nineteenth century. In 1882 Dr. von Eykman isolated the active principle in rhododendrons from a related Japanese plant and named it asebotoxin. Five years later Plugge found it in rhododendrons and gave it the name andromedotoxin. Finally, in 1899, Dr. Konstantin Archangelsky at the Laboratory for Experimental Pharmacology in Strassburg isolated andromedotoxin, along with rhododendrin and rhododendrol from the leaves of *R. chrysanthum,* the snow-rose of Dr. Koelpin's book. It was a

(Continued on page 33)

THE GROWTH OF A TREE

By EDWIN H. KETCHLEDGE

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A TREE IS MANY THINGS. To some people it is a valuable source of essential timber, of fuel, or other raw material necessary for human existence. To others it may simply be another plant which, lacking identity, blends into the green fabric of vegetation clothing the landscape. To still others a tree may be an exciting object of beauty, a source of pleasure whenever viewed. In a sense, then, a tree is really a mirror reflecting our individual makeup — each of us sees it somewhat differently, with our own set of values.

From a purely biological viewpoint, trees are complex biochemical machines which convert light energy from the sun into chemical compounds needed in plant metabolism; foods so formed are used in growth processes to build up functioning tissues and organs. It is my intent to discuss this biological dimension of trees, to review their structure and function and how they grow. When an example is required to demonstrate particular characteristics, I shall refer to the sugar maple, *Acer saccharum,* the state tree of New York.

To understand the basic organization of a tree, we must step back in time to observe that all forms of higher plant life are different answers or compromises to one fundamental challenge encountered by plants in mid-Paleozoic time some 400 million years ago. Before the landward movement plants had it easy, in a way, because the ocean environment is relatively uniform and stable: there temperatures change very slowly; the entire plant is bathed constantly with water containing all the dissolved minerals and gases necessary for making foods; there is little need for specialized tissues to support a weighty stem or to conduct water and minerals to the extremities of the plant body; no water-tight layers are required to prevent drying out; a simple root will suffice to anchor the plant; reproduction is easily accomplished by swimming sex cells. In all, a very hospitable place for plant growth.

When first on land, plants faced a fundamental dilemma: in a terrestial environment the several resources needed for plant growth came from different directions! Water and minerals came from the soil, while light, oxygen, and carbon dioxide came from the air. Thus the plant needed a subterranean root system and an aerial shoot structure. A strengthening system was required to hold the plant aloft in the less buoyant aerial environment and, similarly, a conducting system to transport food, water, and minerals throughout the plant body; a different type of leaf was needed, one with a protective coating to prevent excessive water loss, yet with some device to admit gases into and out of the leaf. Changes were necessary in the reproductive structures so that fertilization could be accomplished in air instead of water; tough, resistant seeds or spores were needed to carry the plant through unfavorable seasons. Complex problems, indeed — each calling for special adaptations.

Perhaps the best way, now, to examine the structure and functioning of a tree is to follow its activities during an annual growth cycle, that is, through one growing season. For sugar maple, this means starting in the middle of winter when the tree is outwardly dormant. I say "outwardly," because even in the depths of winter basic life processes are going on at a slow rate within the cells of the tree; just enough stored food is burned to sustain life during the enforced "inactive" period.

THE ROOTS

The first stirrings of spring are hidden from sight, for it is in the roots that the maple tree first responds to the gradual warming of the land. Roots function at a lower temperature threshold than the branches and, before winter snows have disappeared, are renewing their activities. The first signs of life are strictly chemical; stored foods are slowly converted from their inactive forms, such as starch, to soluble sugars usable in metabolism. As the sap within the tissues becomes more sugary, the cells require more water to maintain their water balance; this is when the delicate root-tips become active again, starting to grow outward between the particles of soil and absorbing water and minerals on the way. All the water a tree uses during the year enters through the thousands of near-microscopic root-tips extending constantly into fresh soil. The large, thick roots of a tree do not participate in this function; rather, they serve to anchor the tree and to help store food reserves. They cannot absorb solutions through their thick wall.

If we could shrink ourselves to the size of an ant and look at one of these root-tips, we would see efficient engineering. The very tip is covered with a cap of slippery cells which protects the actual growing point as it pushes through the soil. As new cells are produced by rapid division of cells within the growing point, the whole tip portion is thereby pushed farther outward; this growth process accounts for the continuous extension of the root system into the soil. Meanwhile, just to the rear of the tip and in that portion which remains stationary, the new-formed cells begin to differentiate into several tissue types. Most important of these in the early spring are the root-hairs, the cells which do the actual absorbing for the tree. The root-hairs form a narrow, fuzzy zone just behind the root-tip. Each hair-cell is really a narrow outgrowth of an epidermal (surface) cell of the root and has a very thin wall

through which water and dissolved minerals are able to pass into the tree. Each root-hair remains functional for only a short time. However, since the root-tip is constantly growing outward, leaving a zone of new root-hairs in its wake, the tree is never without its absorbing tissue. On the inside of the rootlet other important types of cells are differentiating: wood cells in the very middle, bark cells toward the outside, and a thin cambium or growth layer between them. More on these three types of cells later.

Because a tree is a long-lived plant, its root system increases in size year after year. In fact, there is a balance or ratio maintained in a plant between the size of the root system and that of the shoot system; as the tree grows taller and more massive, a progressively large root system is needed to support the aerial portion. In time, the roots spreading outward come into contact with roots of adjacent trees; if of the same species the roots may form a graft and become organically joined. When trees connect in this manner, they may share stored foods or other metabolic products; if one of the trees is cut down, its root system may stay alive for years, nourished by the grafted partner. Various tree diseases may likewise be transmitted from one tree to another through root grafts; one of the most important plantation diseases in New York State, a root-rot caused by the fungus *Fomes annosus,* appears to spread through a stand by root unions after having become established on the stump of a freshly cut crop tree. Similarly, poisons sprayed on one undesirable weed tree may "flash back" across root-grafts into surrounding crop trees, killing trees not touched by the original spray.

As the main lateral roots grow outward, smaller side rootlets are producing along their length. In many tree species these lesser roots become infected with certain fungi but, instead of suffering from the attack, the rootlets actually function better. In an otherwise healthy tree such mycorrhizal roots, as they are called, are beneficial infections only and seem to increase the efficiency with which the roots are able to take in water and minerals. Some tissue and food are lost to the fungus, of course, but overall the tree gains in the exchange. Many of the ordinary mushrooms on the forest floor are mycorrhizal on the roots of trees a few inches below. In fact, most conifers do not have the root-hairs usually found on most of the hardwood trees; for them, mycorrhizal roots are critically important in assisting absorption. Experience in reforesting abandoned farmlands demonstrates that conifers, such as red spruce, will grow poorly in plantations unless the soil is first inoculated with small amounts of forest soil containing the mycorrhizal fungus necessary to the tree.

Because many mycorrhizal fungi form associations with more than one tree species, the fungal tissue may serve as a connecting link, physiologically joining all the woody plants in the stand together.

In one recent experiment, a biologist treated the stumps of several freshly cut red maple trees with a solution of radioactive chemicals; in a few days the tracer isotopes turned up in the tissues of nineteen different woody species growing nearby, apparently having passed via the mycorrhizal network throughout the root mass of the entire stand. One could not imagine a more dramatic example of the dynamic interrelationships between the diverse life forms constituting a forest community!

BUDS AND BRANCH

To return to our story — a host of growth activities in the roots initiates the new season. When the buds begin to swell in May, the tree is well on the way to full vigor.

During summer and early autumn a bud develops at the base of each leaf, thus assuring a new growth of leaves after the long winter dormancy. The bud is really an embryonic branch with growing point, tiny leaves, and, in some cases, undeveloped flowers, the whole enclosed in one or more layers of protective scales. The scales, generally hard and leathery, prevent the drying of the delicate tissues within.

The buds of sugar maple occur in pairs, one on each side of the twig, since this is the way the leaves are arranged. If we were to follow the opening of a typical bud in May, we would see a very slow swelling of the bud over a period of about a week. Then the spectacular flush of spring comes on quickly in just a few days; the bud scales are pushed apart as the embryonic branch and leaf cells grow larger, absorbing water and sugars now flowing from the supporting branch; each cell doubles in size, then doubles again, and again. If we pulled apart an expanding bud, we would see a compact bundle of embryonic leaves clustered tightly around a short stem. The individual leaves, if we examined them under a magnifying glass, would be recognizable as those of a maple. Meanwhile, unnoticed at the tip of the stem and at the base of each leaf is another embryonic region which in late summer will develop into new buds for the next year. In a week to ten days the leaves will quickly expand to their adult size. Growth from existing cells contained in the overwintering buds is now complete. For the rest of the season additional growth will come from the production of new cells in the growing point at the end of each young branch — much as is the pattern in roots.

In sugar maple some of the opening buds are primarily flower-buds. About a dozen flowers may emerge from such a bud and be fully expanded in a few days, before the leaves appear. The individual flowers are borne on stalks an inch or two long, the clusters resembling a tiny bouquet. The pale yellow aura of a sugar maple in spring is due to thousands of such flower-clusters dotting the crown. As the yellow turns to yellow-green and then to green, this indicates that leaf expansion is catching up with the flowers, and in a few more days the leaves will be fully developed. Not so with the flowers, since the fruit takes nearly three months to mature. By late August each fertilized flower has developed into a pair of winged seeds, the maple "keys" so familiar to the woods traveler. Each seed is actually an embryonic plant, at a suspended stage of growth, complete with stem-tip, root-tip, embryonic

leaves, and sufficient food reserve to support its growth for two or three weeks in the spring.

The embryonic cells at the tip of each new branch growing out from the bud are dynamos of growth activities. The whole spectrum of cell types in the mature branch derives from differentiation of these unspecialized cells. One of the interesting aspects of the production of new cells at the growing point is the release of hormones which influence growth farther down the tree. The best-known growth-regulating hormones, collectively called auxin, have different effects on different tissues depending upon their concentration. In shoots, auxin seems to accumulate on the shaded side of tissues. Here it causes the cells to elongate, thereby twisting the young stem upward or outward to the light.

The same mechanism helps to explain why leaves bend toward the light — the side away from the light grows faster, causing the leaf stalks to align in the direction of the light rays. Just the opposite occurs in the root. In the absence of any light, the auxin moves to the lower side of the root. There it inhibits the growth instead of accelerating it; consequently, roots tend to grow downward in the soil. In general, low concentrations of growth-hormones in plant tissues stimulate growth, but high concentrations disrupt it.

Because we know the chemical composition of auxin, we can apply synthetic auxin to plants, regulating their growth to suit our requirements. Orchardists, for example, spray auxin-containing compounds on apple trees to retard fruit drop, and home owners spray strong concentrations of 2, 4-D, another growth-regulator, on lawns to kill weeds by upsetting their metabolism.

In most trees, the two or three feet of top growth and branch elongation are completed during the first half of the growing season. If growing conditions are especially favorable in July and early August, a few species may "break-bud" and go through another short spurt of growth. By September the branches of all native trees at this latitude have completed their terminal growth and the only detectable activity is the internal maturing (hardening) of buds and other tissues. From November on, the only sign of life in the shoot of the tree is the slow respiration of the living cell. Growth, as a process, has ceased for the year.

The Trunk

While the buds are unfolding, another growth process, much more complex, is going on under the bark; in fact, this process—the lateral growth of the woody stem—started earlier in April after the roots became active. Growth here is a beautiful example of how structure and physiology in a plant go hand-in-hand as one process.

The trunk of a tree is a dual system which simultaneously serves two ends: it passively supports the massive food-making apparatus in the crown; and it transports liquids up and down the stem in a two-way flow. Because the shoot portion of a tree may weigh tons, the trunk must be exceptionally strong; at the same time it must be hollow enough to transport water to and from the leaf-tip and root-tip. This seemingly contradictory requirement in biological engineering was achieved during evolutionary time through the development of very long, thin, hollow cells with very thick, rigid walls.

In a sense, the entire root-shoot axis of a tree is a tightly bound bundle of such cells, those on the inside long and thick for supporting the tree and for conducting great volumes of water upwards, those on the outside shorter and thinner for transporting small amounts of water and dissolved food products downward. This picture is complicated by the fact that sandwiched between the two is the actual growth layer that produces the whole thing!

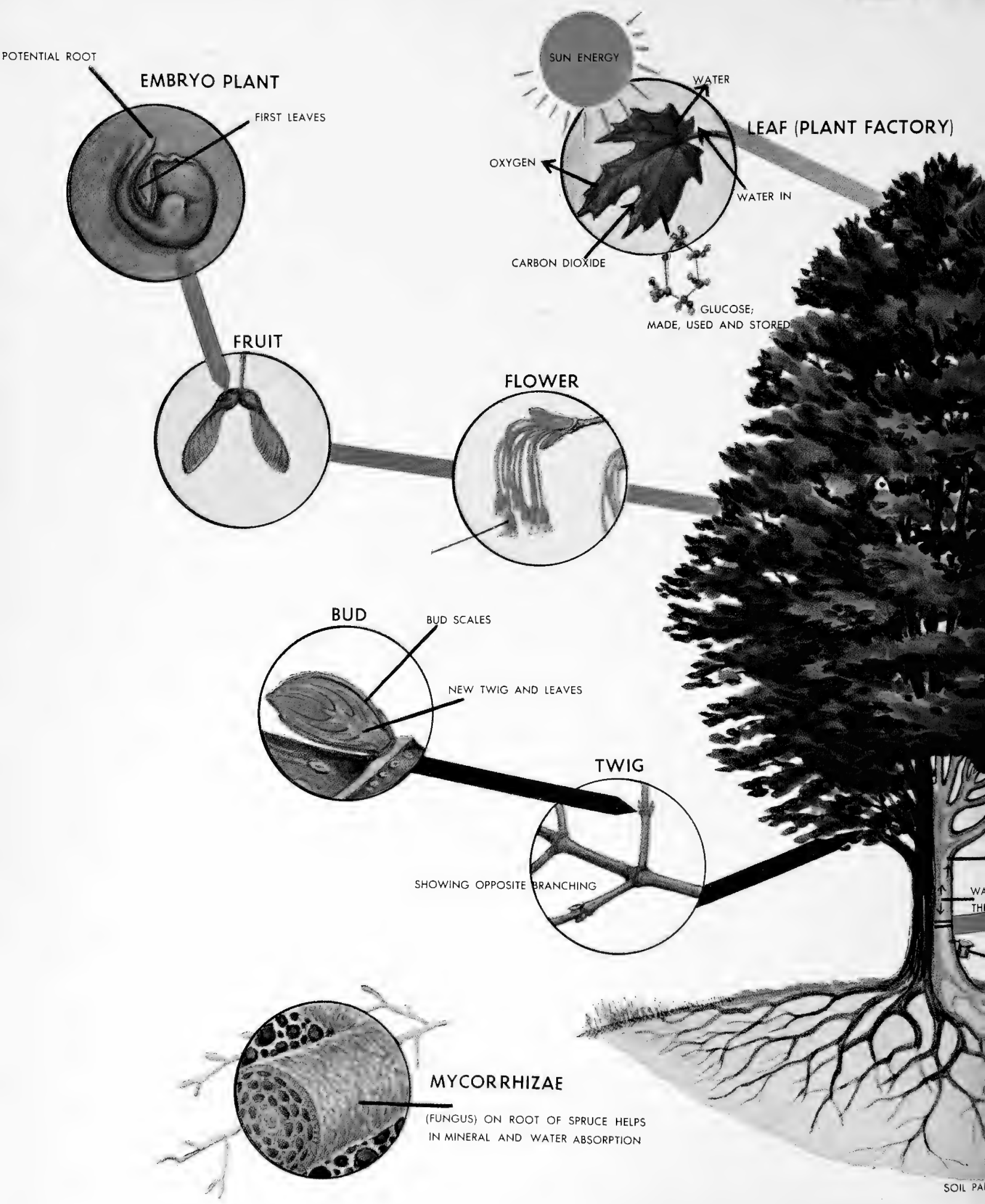
In a woody stem the growth layer, termed the *cambium,* is a microscopically thin sheet of cells separating the bark from the cylinder of wood inside. In April, when the buds are about to open, the cambial cells begin to divide very rapidly. After each division one of the two new cells, thereby formed, gradually matures into a *xylem* or wood cell, if it happens to be located toward the inner side of the tree, or into a *phloem* or bark cell, if it is on the outer side of the cambium. The other new cell invariably remains a cambial cell; once it has grown back to the original size, it divides again, and the process is repeated, perhaps this time producing another xylem cell, perhaps next time a phloem cell. (Actually, during the year many more xylem than phloem calls are produced by division of the cambium.)

Before the season is far advanced, the cambium has produced a new layer of xylem cells laid down upon the existing column of wood, and a new layer of phloem cells lining the inner surface of the bark. Because the center of the tree is already occupied by the cylinder of wood produced earlier in the life of the tree, the cambium and phloem tissues are pushed horizontally outward away from the interior of the tree; this, in part, is what most people mean when they say a tree grows—it increases in size, in this case in width and girth. Along its entire length, then, the trunk becomes thicker. It does not move upward; the only upward growth in a tree occurs by the addition of new cells at the ends of the branches where twig tissue is laid down by the growing points.

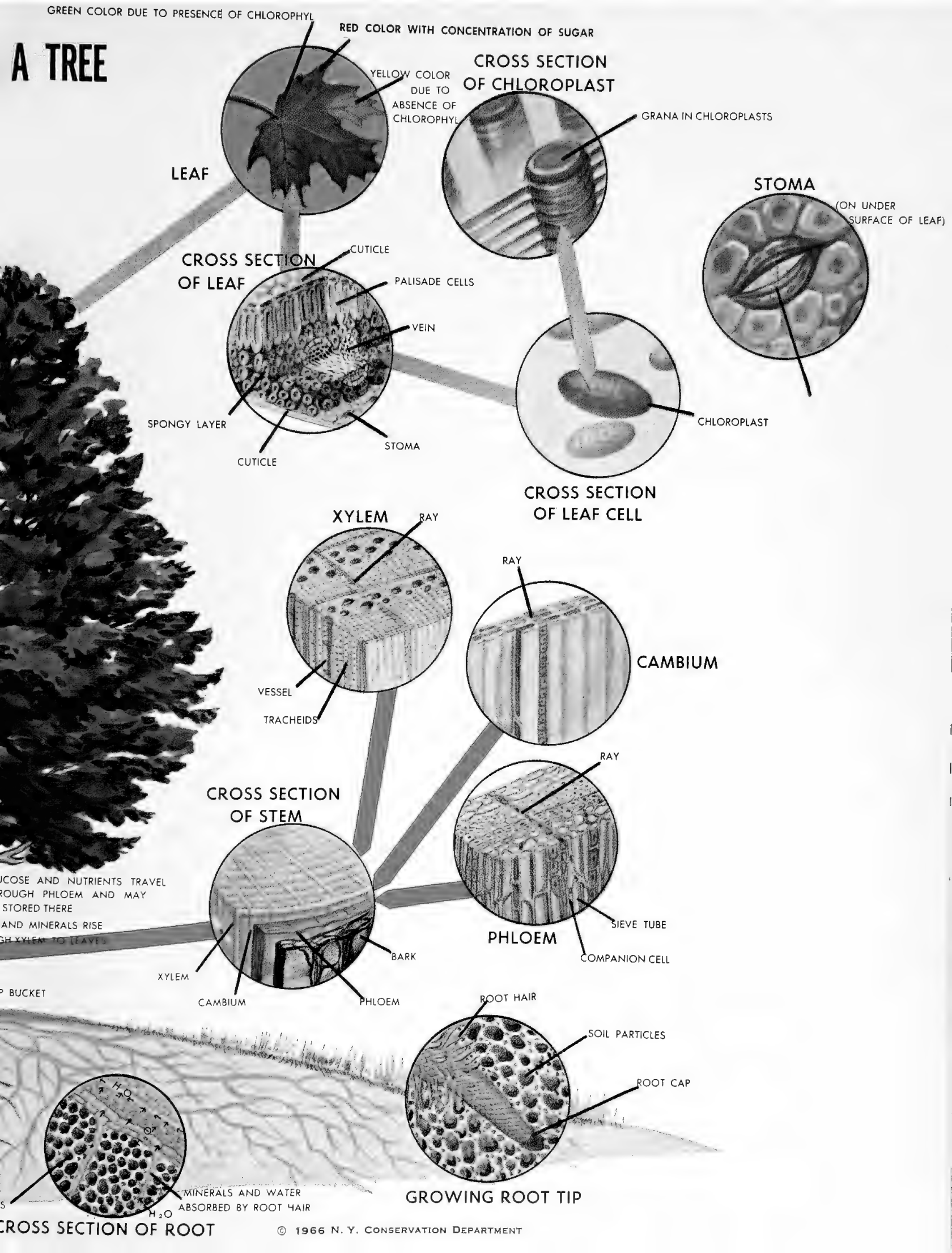
If we were to look for a moment through a microscope at the wood of the sugar maple, we would see several types of cells. The most conspicuous cells would be large vessel cells, individually resembling sections of round drain-tiles stacked vertically end to end. As the vessel cells laid down by the cambium slowly mature, their two end walls disappear and their side walls thicken; the cell dies in the process, as all its protoplasm (living matter) is converted into long strands of cellulose solidly cemented together with lignin, a gummy compound. The tiers of cells thus formed become functionally a single long pipe passing up and down through the tree, the individual sections (cells) of which are now strengthened much like reinforced concrete.

The first of the vessels formed in the spring are often very large in diameter, easily visible with the naked eye, but later in the season, say July and August, their diameters decrease and fewer are produced. It is this

GROWTH C


POTENTIAL ROOT
EMBRYO PLANT
FIRST LEAVES
SUN ENERGY
WATER
LEAF (PLANT FACTORY)
OXYGEN
WATER IN
CARBON DIOXIDE
GLUCOSE;
MADE, USED AND STORED
FRUIT
FLOWER
BUD
BUD SCALES
NEW TWIG AND LEAVES
TWIG
SHOWING OPPOSITE BRANCHING
MYCORRHIZAE
(FUNGUS) ON ROOT OF SPRUCE HELPS
IN MINERAL AND WATER ABSORPTION

A TREE



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difference in size and numbers of wood cells which enables us to recognize each annual growth layer in a log or stump: large pores (vessels in end view) mean spring growth, small pores summer growth, with the area of gradual change from the former to the latter representing the growth of a single year.

It is a curious fact that all the water a tree uses during the year must flow upward in this dead, outer portion of wood. Moreover, after several years these dead cells lose their conducting effectiveness and the newer, more recent wood cells take over. When the interior portions of the trunk can no longer be used even for food storage, it ages and discolors, forming what we call heartwood as opposed to the still functional sapwood around the younger portion of the cylinder.

Mixed in with vessel cells are longer but narrower *tracheid cells* which taper to a point at their ends. These cells do not abut end to end with cells above and below; instead they overlap along their sides. As a consequence, water can only pass slowly through these tracheids by means of the small holes, called pits, which are found between adjacent cells in all woody tissues. Three other types of cells are also present in sugar maple and most other hardwoods: very thick-walled *fiber cells* which serve to toughen the wood further; living *ray cells* which run laterally into the wood from the phloem, carrying food reserves; and living *storage cells* which assure food for growth the following spring before the new leaves function.

If we now look at the phloem, we shall see an analogous group of tissues. In the inner layers the broad, vessel-like, conducting cells, called *sieve tube cells,* retain their protoplasm and remain living for the several years they function. In addition, they are accompanied by companion cells which seem to aid in regulating the downward flow of water and its cargo of food. Fiber cells are also present, as are ray cells which intercept food and shunt it laterally into the xylem storage cells. Another growth layer, the *cork cambium,* is generally present in the middle of the phloem tissue. As its name implies, it produces corky cells toward the outside, thereby providing a water-tight cover around the trunk. As the outer bark wears off, it is replaced by cells from the cork cambium deeper within the bark. Both the xylem and the phloem of the shoot differ in no substantial way from those of the root; in each, lateral growth, internal structure, and function are essentially identical.

By the time leaves are out on the sugar maple in late May, a new ring of large xylem cells is generally functioning just under the bark. The cambium continues to produce new wood and bark cells actively during the spring and early summer and only slows down as midsummer approaches. If at any time the early-season growth of the tree is interrupted by a prolonged cold or dry spell and resumed with the return of favorable weather, a false growth ring may appear in the wood where the large vessel cells are once more produced abundantly. In late summer and autumn cambial activity ceases, and the cells remain quiescent until the warming temperatures of spring rekindle their activity.

In the spring, when food reserves are converted into

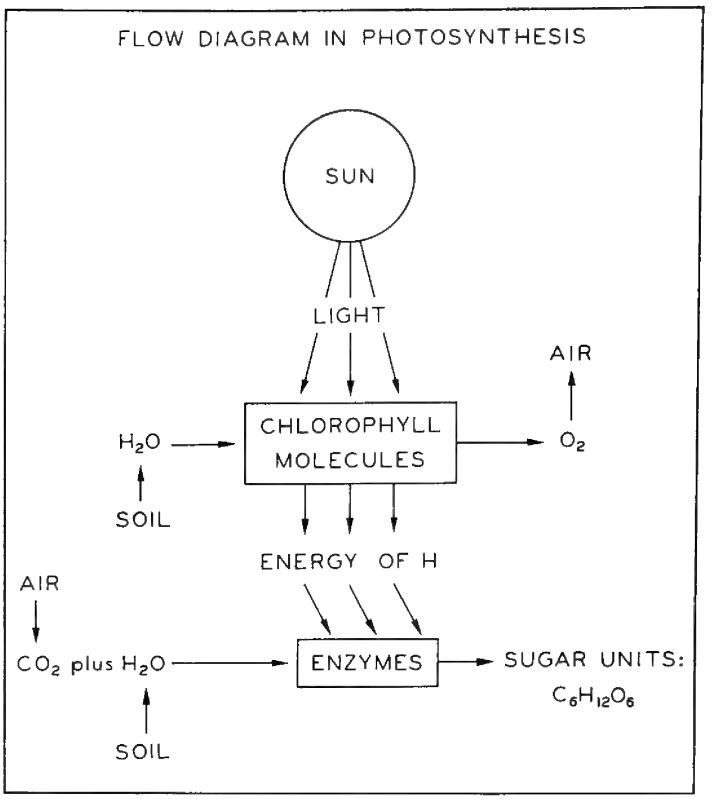


Figure 1.

sugars, the sap of a tree becomes so heavily concentrated that water tends to diffuse through the roots into the tree. This causes pressure within the trunk so that, if the bark is ruptured, sap will "bleed" from the wound; this, of course, is what happens in the spring when we "tap" a sugar maple.

After the sugars have been used up in forming new tissues, what causes the water to flow into and then up a tree? What force produces the lift? *The leaves!* As leaves lose water to the surrounding air (a process called transpiration), the water column inside the tree is pulled upward. As one molecule of water is vaporized from the leaf another molecule moves in, so to speak, to replace it and another to replace that, and so on down the tree. Because the tree is water-tight and because water molecules have high cohesion, the lifting force is transmitted all the way down to the root-hairs. Water is literally pulled up, molecule by molecule, from cell to cell, by the evaporation of water from the leaves.

In a sense a tree is a biological wick. The water loss varies according to the species and the weather. In New York State a tree receives about forty inches of precipitation a year; about twenty-five inches of this is lost by transpiration. A negligible amount of water, say two per cent, is used in photosynthesis. The water may pass upward slowly, perhaps only a few inches on a muggy day, or very fast, nearly five feet an hour, on a breezy, dry day.

The Leaves

The last type of growth I shall review is the production of new leaves on the young branch, as it grows outward in late spring and summer after the spring flush. Each leaf starts as a minute growing point along the

side of the developing stem-axis. About two or three weeks are required for a point to develop into an adult leaf. The basic leaf structure of all hardwoods is essentially the same; only the size and shape differ among the species. If we were to cut a leaf across the blade and then look at the exposed edge, we would see two layers of cells: in the top half of the leaf, a region of densely packed tissue of palisade-like cells which are the major photosynthesizing (food-making) cells; and below it a spongy, loosely packed tissue through which air and water vapor diffuse freely. Examining the leaf by full-surface view, we see that veins of decreasing size branch from the leaf stalk (petiole) into the blade. Regardless of size, each vein consists internally of a small bundle of xylem cells at the top, bringing in water and minerals, and below a similar clump of phloem cells transporting food back into the main phloem system. Functionally, each vein is thus an extension of stem tissue into the food-making apparatus, the leaf.

The top and bottom surfaces of the leaf are covered with a transparent and water-proof epidermis, only one cell thick. The lower epidermis has small openings, *stomata,* through which gases and water vapor enter and leave the interior of the leaf. The stoma is a simple but effective assurance against any internal drought within the nearby photosynthesizing tissues. Structurally it is just a little slit between two so-called guard cells which regulate the flow of water vapor from the leaf. When full of water, the two guard cells, shaped like bananas, swell outward away from each other and thereby create the pore between them through which air may pass; but if the guard cells begin to wilt slightly, as when the leaf is losing water too fast, they collapse and so close the pore.

The most important function occurring in any green plant is the food-making process or photosynthesis. Although not a growth process in the strict sense of that word, it is the one physiological activity that fuels all other phases of metabolism in the plant and that explains the need for the complex structures of root and trunk. All vegetative activity, all growth in the plant, serves to support this most important of its chemical processes.

Photosynthesis, simply stated, is the conversion of two low-energy, inorganic compounds, carbon dioxide from the air and water from the soil, into one high-energy, organic compound, simple sugar (see Figure 1). Radiant energy from the sun provides the outside force to drive the process. The chemical conversion occurs when the green-leaf pigment, chlorophyll, absorbs sunlight and passes the energy on to food-forming enzymes in the cell. Some of the sugar is subsequently burned to supply energy for life processes, some is built up into more complex molecules used in growth, and the remainder is stored for later use.

Although the process may sound simple, photosynthesis is really a complex series of reactions not fully understood. We know that the chlorophyll is "activated" or "excited" by the light rays striking it. About eighty-five per cent of the light striking a chloroplast is absorbed, thus making it a very efficient engine. In this energized state, a chlorophyll molecule is able to split or dissociate a molecule of water into its component hydrogen and oxygen atoms. The oxygen is released from the leaf as a by-product gas. Meanwhile, the hydrogen is joined, through a series of intermediary compounds and enzyme reactions, to the carbon dioxide, to yield an energy-rich carbohydrate—that is, a compound containing carbon, hydrogen, and oxygen.

The primary product of photosynthesis is a simple 6-carbon-atom sugar, glucose. The chemical energy stored in the sugar molecule is now put to work by the slow oxidation of the molecule, that is, by burning it enzymatically with oxygen to release its stored energy. This latter process, just the opposite of photosynthesis, is termed respiration. Actually, a leaf-cell respires at all times in order to get the energy required in its life processes; during the daylight hours, of course, it makes much more glucose than it burns, whence the excess to support growth elsewhere in the plant.

In a leaf-cell the chlorophyll molecules are localized in small spheres called chloroplasts. Even here the chlorophyll is concentrated in stacked disk-shaped structures, *grana,* the sites of food production. The chlorophyll exists in two forms, *a* and *b*, differing slightly in structure and absorbing characteristics. Both molecules absorb only the red and blue portion of the light spectrum; the yellow and green portions pass through the leaf unused. Most leaves also have accessory pigments which help absorb light energy—carotene, an orangish pigment, and xanthrophyll, a yellowish one. These pigments pass along their energy to chlorophyll *a,* the only pigment capable of splitting water.

Chlorophyll itself is very dark green but, mixed with the accessory yellowish pigments, gives the leaf its light green color. The color remains constant during the growing season while the leaf is healthy. In the fall, however, a corky layer develops at the base of the petiole, cutting off the flow of water and sap into and out of the leaf. The chlorophyll molecules, unable to function, slowly deteriorate and lose their green color, and the yellowish pigments are at last revealed. Moreover, along with the increase of sugar in the leaf during the last few days before the flow of sap ceases entirely, another pigment appears—anthocyanin. Curiously, this last pigment is dissolved in the cell contents and changes in color from pink to purplish, depending upon the acidity of the cell fluids.

Generally, as the leaf cells dry out and wither, the cell sap becomes more concentrated and the reddish color correspondingly darker. Other chemical residues may give color to the leaves, such as the brown tannins in oak leaves. The flash of autumnal coloration now catches our eyes, telling us that the year of the tree is almost over.

STYLITES OF PERU - A LIVING FOSSIL PLANT?

By LAWRENCE J. CROCKETT

Dr. Crockett is Assistant Professor in the Biology Department of The City College of New York, New York.

IT MUST HAVE BEEN FUN to have been a European botanist in the seventeenth and eighteenth centuries. Never-before-described plants were arriving in Europe by the shipload. Students of botany were traveling to almost every part of the globe in search of new plants, and finding them. This is not to say that new and exciting botanical finds are not being made today. Within the last five years, Dr. Bassett Maguire of The New York Botanical Garden and Dr. John Wurdack of the Smithsonian Institution have gone on botanical trips and returned with many new plants, but those "pioneer" days of the seventeenth and eighteenth centuries had a glow all their own.

One of the truly exciting, recent discoveries was made by the famous German botanist, Professor Werner Rauh of Heidelberg University, Deutschland. His wonderful find was made in a cold bog high in the Peruvian Andes. Adding to the excitement was the fact that the new plant had escaped detection, although the flora of Peru has been under careful scrutiny for many years. Imagine his delight in having come upon a plant which was revealed to be a *fifth* genus in the primitive Division of plants known as the Lycopsida! He had discovered what amounts to a living fossil.

The Lycopsida, in addition to the newly discovered plant, includes two relatively familiar genera, *Lycopodium,* the club-moss or ground-pine (Fig. 1), and *Selaginella,* the spike-moss; two generally less-known genera, *Phylloglossum* (found only in Australia, New Zealand, and Tasmania); and *Isoetes,* the quillwort. The Division now includes one more genus *Stylites,* which grows high up in the cold bogs of the Peruvian Andes. Species of *Lycopodium, Selaginella* (Fig. 2), and *Isoetes* can be found throughout the United States.

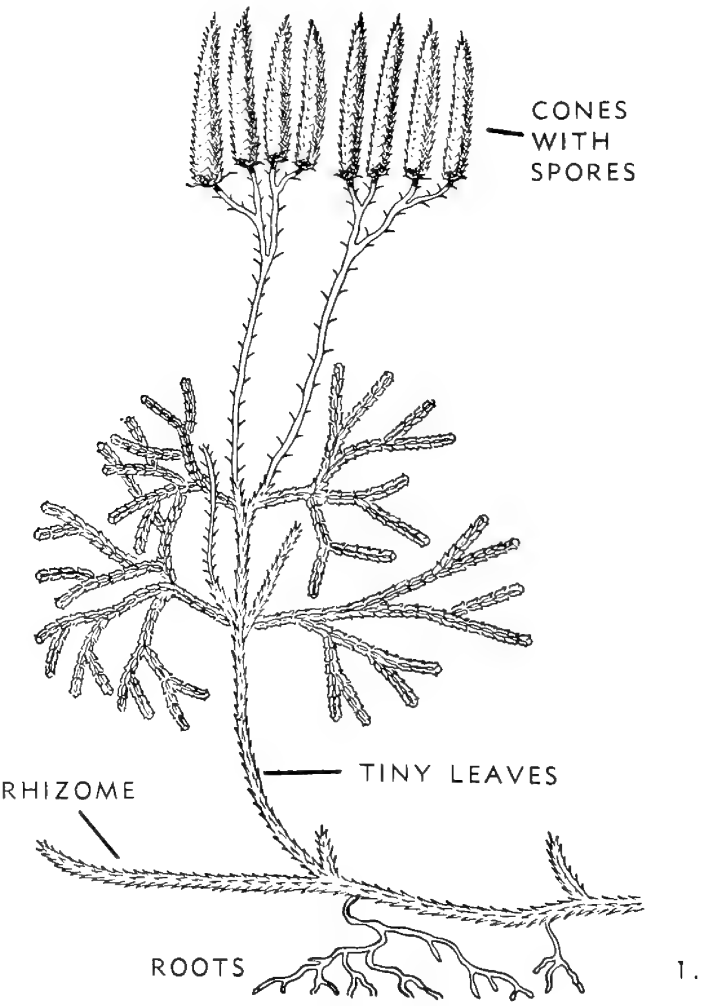
Nature lovers know or probably have seen ground-pine or club-moss whose upright stems sport spirals of small leaves. Club-moss also has a horizontal stem, from which the upright ones arise, that runs along the surface of the ground or just beneath. In many species of *Lycopodium* the leaves at the tips of the upright stems are specialized and produce sporangia. The spore-bearing leaves, and the stem to which they are attached, together form the cone, or strobilus. Each sporangium produces spores all of one size, and the plant is said, therefore, to be homosporous. Masses of lycopodium powder (as the spores are known commercially) burn rapidly and with such a sudden burst of light that it served as the original flash bulb in photography. Each spore is very tiny and contains a quantity of oil. A great mass of spores imparts slipperiness to small objects coated by them, and this quality was once used by pharmacists who coated pills with lycopodium powder in hope, apparently, that they would slide down more easily.

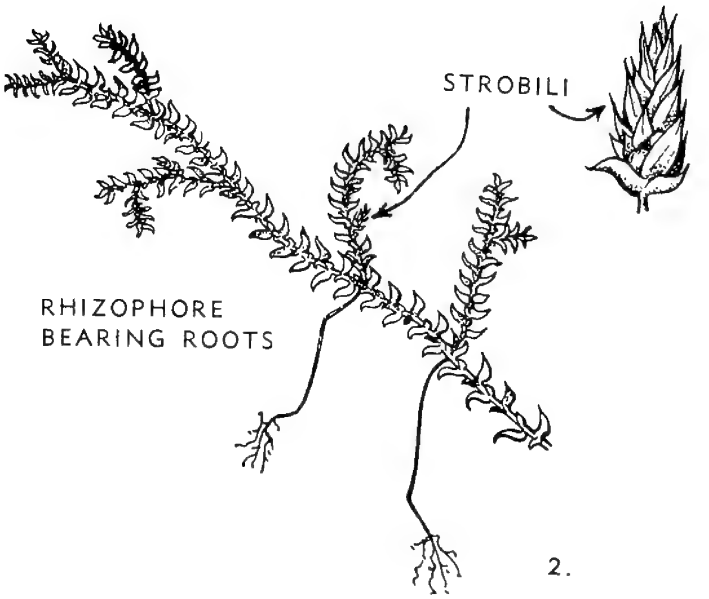
The spike-moss produces smaller dorsal leaves and larger ventral leaves along its stems. Although both *Lycopodium* and *Selaginella* are small enough to be confused with true mosses by the uninitiated, neither is a moss nor even closely related to a moss; all members of the Lycopsida are primitive vascular plants. (Common names rarely take the true relationships of plants into consideration.)

The cones produced by *Selaginella* are especially interesting in that spores of two sizes are found within the cones but are borne in separate sporangia. Known as heterospory, this is an advanced condition for these otherwise relatively primitive plants—all the gymnosperms and angiosperms are heterosporous. One western species of *Selaginella* is the well-known resurrection plant (Fig. 3), which is brown and rolled up when dried out but, when wet, quickly unrolls and turns green.

Isoetes, the quillwort, produces a tuft of thin, pointed, green leaves which look like quills and crown a very short, cormlike, two- to four-lobed stem. Roots are produced in grooves between the lobes.

Figure 1. *Lycopodium.*





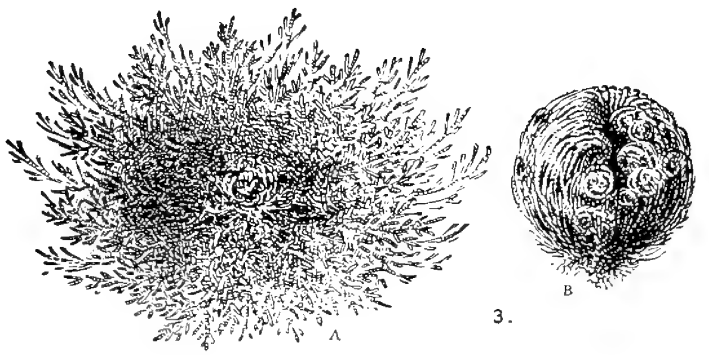
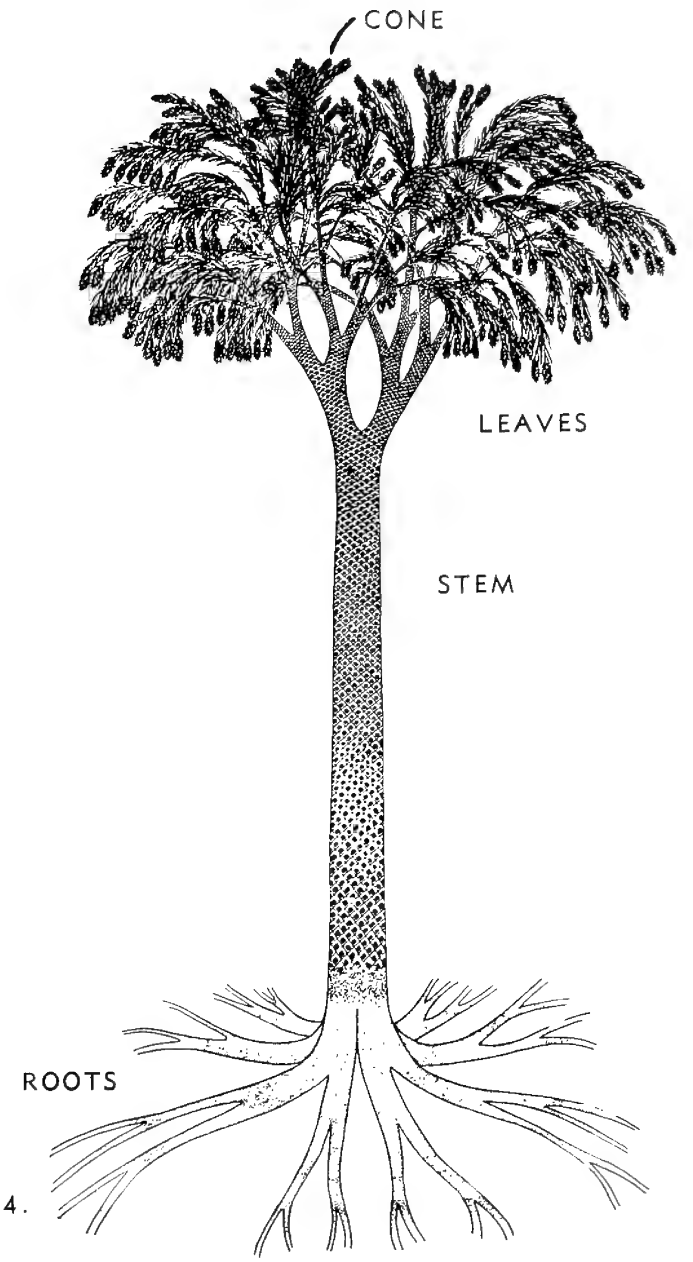


Figure 2. *Selaginella.*
Figure 3. *Resurrection plant.*
Figure 4. *Lepidodendron.*

This interesting Division of plants also includes a number long extinct. Many of the fossil Lycopsida (Fig. 4) of some 250 million years ago were much larger than the living members, some attaining the height of tall trees (120 feet), though today you may scrunch the present-day ground-pine beneath the heel of your hiking boot.

It is *Isoetes* (Fig. 5d) (pronounced I-so′-uh-tees) that is of greater interest to us in the consideration of the new plant, *Stylites* (Fig. 5c), because the latter is in many ways very much like the quillwort, but different enough to warrant the establishment of a new genus. Until *Stylites* was described in 1956, *Isoetes* was—except for certain fossil genera—alone in its family, the *Isoetaceae*. This plant was first described by the great eighteenth-century botanist Carolus Linnaeus in 1751. He, too, was fooled by the plant, describing it as a seed-bearing plant, or angiosperm. Indeed, superficial inspection does lead to the conclusion that the plant is a grass or a relative of the onion. In Europe the quillwort is called Merlyn's grass. (As an example of the kind of sadism rampant in college botany laboratories today, let me offer this: I always set up a mounted, preserved specimen of *Isoetes* as one station of my laboratory practicum and ask, "To which class of angiosperms does this plant so plainly belong?" The number of students who fall for this ruse is delightfully large.) *Isoetes*



has little economic significance, although the leaves are packed with oil and starch and cattle have been seen to graze them.

Species of *Isoetes* are usually hydrophytes—plants which live in or under water for at least part of the year. The stem of *Isoetes* is erect, but strikingly shortened vertically. The inconspicuousness of the cormlike shoot led the seventeenth-century English botanist John Ray to write of this plant, "one sees naught but leaves and roots, and knows not from what source it comes directly." The stem is so short that it is easily overlooked among the clustered, swollen leaf bases and the profusion of dichotomously branched roots. The stem undergoes almost no longitudinal growth, but does have an embryonic region (meristem) at its apex, and the meristematic cells produce leaves and more meristem. A cambium (embryonic cells which add to the girth of the stem) is also present. Near the base of the stem a meristem gives rise to roots.

Among the sixty or so species of *Isoetes* some can be found which produce leaves only a few millimeters in

length and those which produce leaves some fifty centimeters long. Each narrow, awl-shaped leaf generally has a sporangium at its base, which accounts for the basal swelling. In some of the species the short stems and the swollen leaf bases are subterranean, and as a result these portions never develop chlorophyll and appear glistening white, much like the base of onion leaves. Hydrophytes usually possess air chambers in their air-borne or floating leaves, and *Isoetes* is no exception to the rule. Four large air chambers are found in the upper portion of the sporophyll (leaf with sporangium). Through the entire leaf runs a single, unbranched, simple vein.

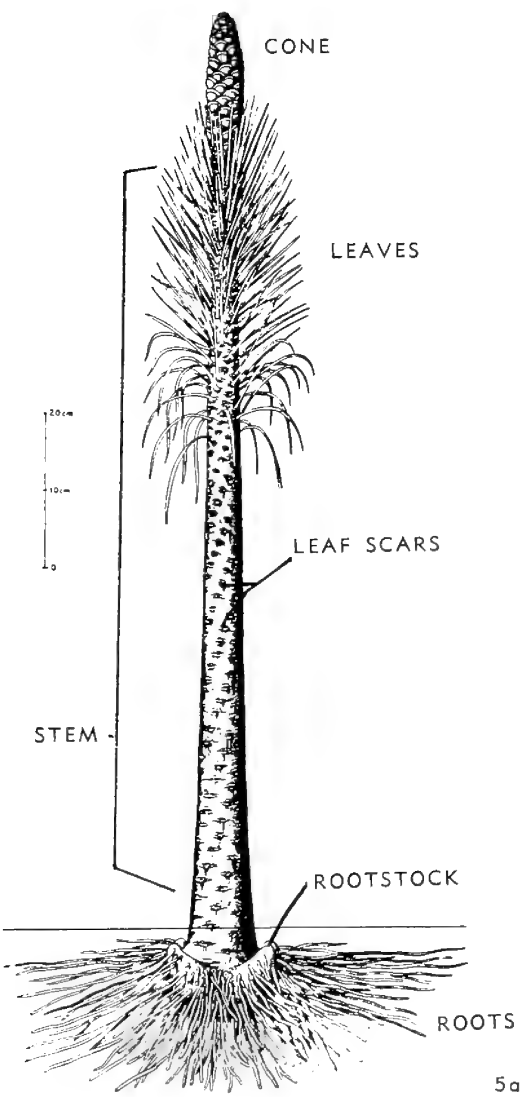
The sporangium at the leaf's base is sunken and covered by a veil of tissue (velum) which, curtain-like, hangs down over the sporangium from above, protecting it. Just above the velum, a ligule emerges from the leaf and projects upward. This little understood but highly interesting tongue of tissue had been found on only two living genera of plants, *Isoetes* and *Selaginella,* until the discovery of *Stylites*. Although several fossil genera, including the treelike *Lepidodendron* (Fig. 4), possessed ligules, the real significance of the ligule has thus far escaped detection; no doubt it is a vestigial structure once of considerable value to the plant. It is of further interest that all plants bearing ligules are also heterosporous, whereas the Lycopsida, which lack ligules, are homosporous.

The roots of *Isoetes* are of considerable interest, too. They branch and always dichotomously. However, it is the inner anatomy of the root which confirms the relationship of *Isoetes* to some of the larger fossil lycopods. The roots of both the fossil lycopod and the living *Isoetes* have a single, excentrically placed vein surrounded by a C-shaped cavity, which is formed by the collapse of cortical cells around the vein, but not entirely encircling it.

When *Stylites* was discovered it was necessary to establish this entirely new genus, although the plant shows very definite similarities to *Isoetes*. That the discoverer of this plant, Professor Werner Rauh, was prevented from naming it is a great misfortune. Dr. Rauh had planned to call the plant *Rhizoetes*. This would have brought its close relative *Isoetes* to mind and made some note of the odd roots found on the plant. However, according to the Rules of Botanical Nomenclature, the name *Stylites,* the first published name, must remain. Fortunately, its name does not detract from the generally interesting features of this plant.

Stylites grows so abundantly that it forms large hummocks. As many as one hundred closely compacted leaves are pressed together, forming a funnel-shaped tuft crowning a stem which may reach eight to twenty centimeters. Compared with the stem of *Isoetes,* this constitutes a striking difference. Stems of *Stylites* are never telescoped or cormlike; they may branch dichotomously. *Isoetes* is occasionally found with a single dichotomy of its stubby stem in evidence, but in *Stylites* dichotomous branching is the rule rather than the exception.

Root production in *Stylites* presents an unusual sight. All the roots emerge from a single groove which runs longitudinally along one side of the stem. Unlike the roots of *Isoetes,* the roots of *Stylites* dichotomize rarely, but may attain a length of twenty centimeters. The in-



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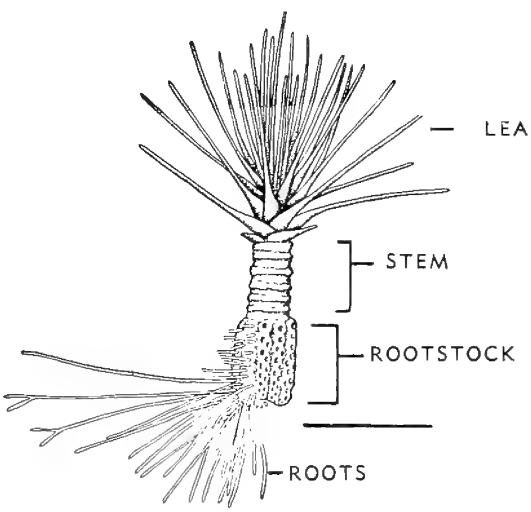

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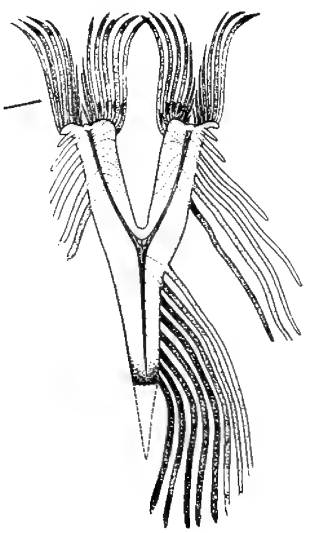

5c

ternal root anatomy of *Stylites* is similar to that of *Isoetes,* a single excentrically placed vascular bundle is surrounded by a C-shaped cavity. The possession of this characteristic alone would make *Stylites* unusual, because so few primitive living plants have it.

Chief among the differences found in a comparison of the leaves of *Isoetes* and those of *Stylites* is the position of the sporangia. In *Stylites* they are always produced one to two centimeters above the base of the leaf, while they are always at the base of the leaf in *Isoetes.* The sporangium is not sunken into the tissue of the leaf base, but is rather raised above the surface on a short, stubby stalk. While the ligules are similar to those seen on a leaf of *Isoetes,* no velum is present. *Stylites* is both ligulate and heterosporous: however, unlike *Isoetes,* which generally produces both types of spores on one plant, *Stylites* shows a strong tendency to produce the large spores on one plant and the small spores on a different individual, that is, *Stylites* shows a definite tendency towards becoming dioecious.

Some paleobotanists believe that two fossils show closer affinities with *Isoetes* than with any other Lycopod. They are the Triassic genus *Pleuromeia,* 160 million years old, (Fig. 5a) and the more recent *Narthorstiana,* 100 million years old, (Fig. 5b) whose incomplete fossils are found in Cretaceous rocks. The unbranched trunk of *Pleuromeia* rose to a height of a meter or more (approximately six feet) and had a subapical crown of long, thin leaves. A cone which formed above the leaves was composed of spirally arranged sporophylls. *Pleuromeia* was heterosporous. In the soil

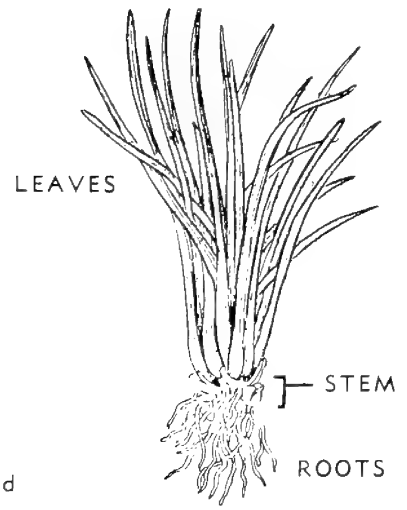


Figure 5a. *Pleuromeia.*

Figure 5b. *Narthostiana.*

Figure 5c. *Stylites.*

Figure 5d. *Isoetes.*

the trunk terminated in four large, hornlike lobes with upturned tips. Each horn bore spirally arranged roots.

Narthorstiana is generally placed in the same order as *Pleuromeia.* It was a smaller plant, attaining a height of about twenty centimeters (about eight inches). Its stem was also unbranched, but roots were produced along several longitudinal ridges at the base of the stem. A crown of slender leaves capped the aerial portion of the stem. Paleobotanists have never found a plant of *Narthorstiana* which was fossilized during sporangia production, so our idea of spore production in this genus is unclear. Some experts believe that *Narthorstiana* represents a stage of reduction between the larger *Pleuromeia* and the much smaller *Isoetes.* A comparison of stems is, of course, of great significance in the establishment of such a hypothetical line of reduction.

With the discovery of *Stylites* a new note has been rung. *Stylites* has an elongate stem, not a telescoped, cormlike structure. *Narthorstiana* may, on the basis of stem comparison, be compared more closely with *Stylites* than with *Isoetes. Isoetes* apparently represents a further reduction of the *Stylites* type. One may hypothesize that a six- to ten-foot-tall *Pleuromeia* type during the Triassic underwent gradual reduction and change which resulted in a line of plants of the *Narthorstiana* type during the Cretaceous. During more recent geological times (although we cannot say exactly when) a *Stylites* type evolved (follow Fig. 5a through 5d). *Isoetes* may represent a still later development and the end of a line of reduction in this group.

It is to be hoped that remarkable discoveries, similar to Dr. Rauh's, will occur again and again—discoveries which will bring back the thrill of botanical exploration so universally felt in the eighteenth and nineteenth centuries.

CHANGE IN EDITORSHIP OF *THE GARDEN JOURNAL*

With her appointment as Editor of the *Journal of The New York Botanical Garden* in June, 1950, Dorothy Ebel Hansell accepted the task of bringing volume 51 to conclusion while at the same time creating a new journal to replace it. Volume 1 of *The Garden Journal* made its first appearance with the January-February issue, 1951. Sixteen volumes later, after sixteen years devoted to editing and managing *The Garden Journal,* Mrs. Hansell has retired in advance of the mandatory age, much to our regret. To replace an editor as skilled and as experienced as Mrs. Hansell is not easy. However, with much pleasure and with no small sense of relief, we now announce the appointment of Elaine C. Cherry as Editor of *The Garden Journal,* effective January 1, 1967. To this responsible position Mrs. Cherry brings an unusually broad range of experience in writing, editing, and printing; we offer her our warmest and best wishes for a happy and successful career.

William C. Steere, Director

ON WESTERN FOSSIL AND LIVING PLANTS

By HERMAN F. BECKER

Dr. Becker is Curator of Paleobotany at The New York Botanical Garden.

THE ACQUISITION of fossil plant collections for study and display at The New York Botanical Garden has become a recurring habit through extended expeditions to fossil localities. This past summer it was "time again" to replenish and expand our Tertiary Horse Prairie flora from southwestern Montana, an assemblage of fossil leaves, flowers, fruits, and seeds which represent the major part of our present research.

Preliminary arrangements for a three-month collecting trip began early in the year, so that by the beginning of June all plans had crystallized, an assistant obtained, and tools and equipment shipped into the field. The chief areas of operation were southwestern Colorado, western Montana, Berkeley, California, and British Columbia, resulting in about thirty-five hundred fossil plant specimens, and a thorough study of Tertiary type specimens at the University of California in Berkeley.

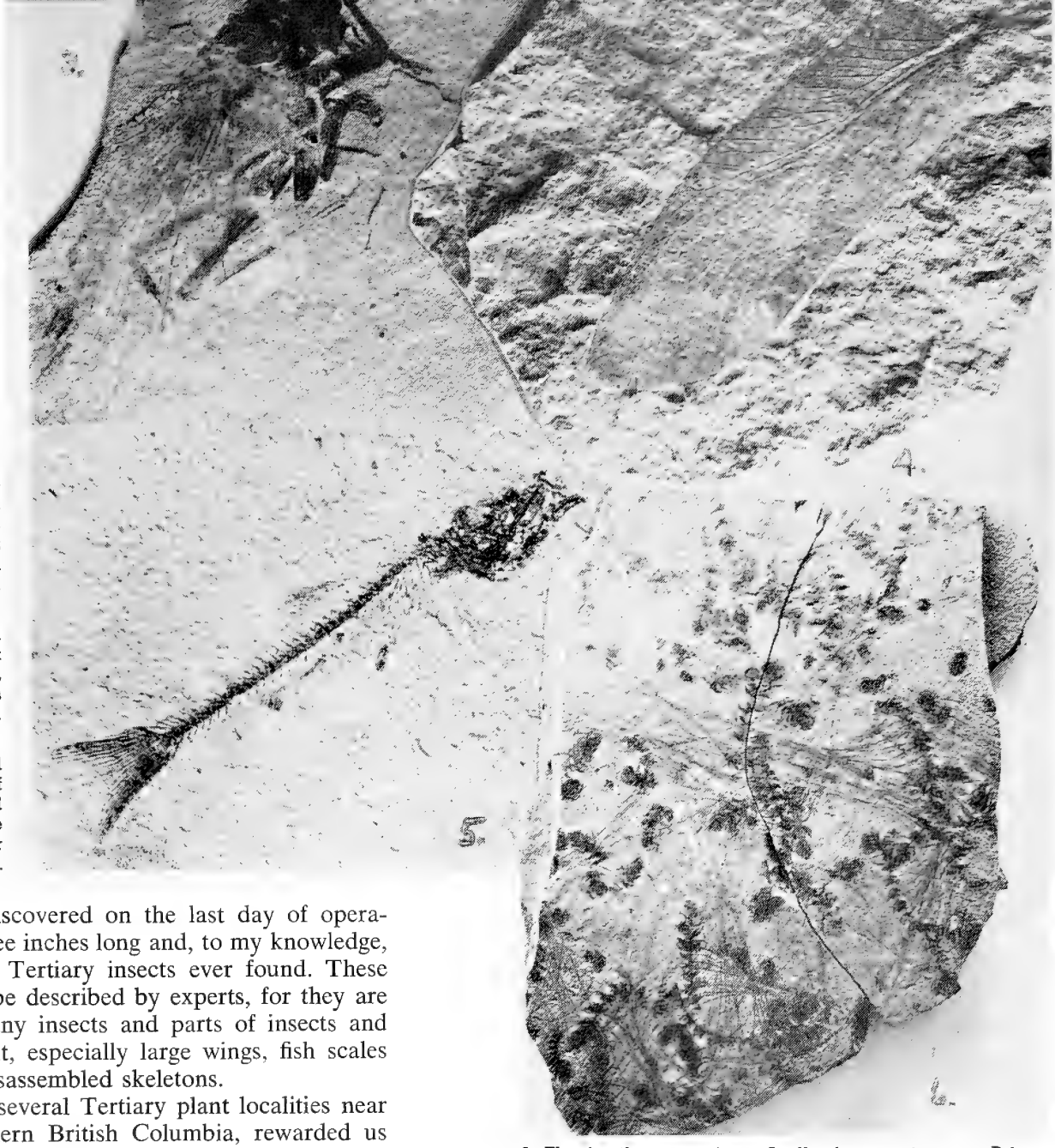
During a three-month collecting trip or expedition there are, of course, incidental as well as planned aspects which cannot be ignored. An itinerary was arranged that touched on botanical and other public gardens, on mountain areas which promised to yield interesting wild flowers, and on regions which were geologically valuable to the work.

In recent years several universities have added paleobotany courses to their curricula. These budding departments are of great value, since they reflect an increasing interest in and importance to the discipline, but especially since they are staffed by excellent and promising young men. Alma College at Alma, Michigan, under Dr. Ronald O. Kapp, the University of Missouri at Columbia, Missouri, under Dr. Joseph M. Wood, and the University of Montana at Missoula, Montana, under Dr. Charles N. Miller, are only three recent additions among many. These young men received their training at the University of Michigan, and two were my able field assistants during earlier expeditions. All these institutions can boast of excellent fossil plant collections acquired within short distances of their campuses. Missoula is especially well situated for this purpose, with many untapped Tertiary fossiliferous beds in the vicinity. A one-day collecting trip to nearby Drummond yielded approximately two hundred specimens.

The area around Grant, Montana, our present fossil research region, is equally fertile, with inexhaustible Tertiary fossil outcrops in the Grasshopper Valley, the Medicine Lodge and Horse Prairie Valleys, in Schwartz Creek and in Muddy Creek, all located just a few miles east of the Continental Divide near the Idaho State line. Aside from unusual plants, new surprises reward the collector at every turn. Several specimens of rare, complete fishes were found, one to two inches long, and perhaps the smallest of all known Tertiary species. Furthermore, a complete orthopteran insect (grasshop-

Left. The gallery in the Climatron at the Missouri Botanical Garden permits a more intimate view of tropical and other plants.

Below: This ledge of solid red sandstone of the Dolores Formation near Placerville, Colorado, contains leaves of *Sanmiguelia*, a palmlike plant.



3. An as yet unidentified orthopteran insect, three inches long, from Schwartz Creek near Grant in southwestern Montana.

4. An unidentified fossil insect wing, two and a quarter inches long, from the Tertiary beds near Grant, Montana.

5. A newly discovered species of fish, one-half inch long, may shed light on the age of the fossiliferous beds near Grant, Montana.

per group) was discovered on the last day of operations. It is over three inches long and, to my knowledge, one of the largest Tertiary insects ever found. These species remain to be described by experts, for they are doubtless new. Many insects and parts of insects and fishes came to light, especially large wings, fish scales of all sizes, and disassembled skeletons.

A brief visit to several Tertiary plant localities near Princeton in southern British Columbia, rewarded us with numerous compressions of *Azolla,* a floating aquatic fern which has hardly changed to this day.

All fossils mentioned are of mid-Tertiary age (twenty-five to thirty million years old) with the exception of the purported, palmlike *Sanmiguelia* from the Triassic Dolores Formation in southwestern Colorado. A second visit (first visit in 1964) to the area this summer was designed to gather more evidence of the plant's true taxonomic status, but such evidence was not forthcoming. These taxonomically disputed leaves occur in solid sandstone near Placerville along the San Miguel River, in steep bluffs which border the unspoiled, majestic valley. If sanmiguelias are indeed palms, they would represent the oldest-known flowering plants and would considerably upset our conventional idea of the origin of angiosperms, making the monocotyledons ancestral to the dicotyledons. From a morphologic and taxonomic viewpoint the reverse appears to be true. Leaves of *Sanmiguelia* resemble seedling leaves of the coconut, or mature, plicated leaves of *Veratrum,* our northeastern false hellebore. The true status of this plant may never be known, since no attached leaves, petioles, or

6. The fossil aquatic fern, *Azolla,* from a site near Princeton, British Columbia, is almost indistinguishable from the present living form.

stems were found nor was there evidence of flowers, fruits, or seeds. A compensating factor for the disappointment in this fossil area is the magnificent scenery, the turbulent mountain streams, the tree-clad slopes which end at the old mining town of Telluride, about twelve miles to the east. The region is surrounded and partially hemmed in by a score of mountains over fourteen thousand feet high, snow-covered during the summer, and part of the most scenic "colorful Colorado" Ouray-Silverton complex.

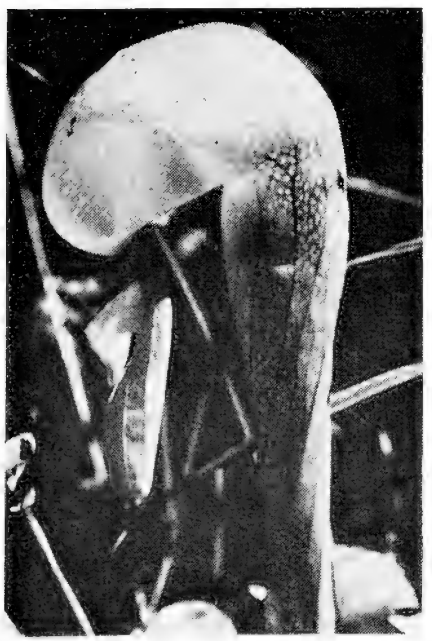
Anything important or unusual occurring in such a remote area cannot long be hidden from the curious population. Somehow *The Telluride Times* had heard of our activities, and its editor descended on us, sensing a "hot" scientific story. The result was a headline in the July first issue, proclaiming "Ancient Fossilized Leaf Discovery Near Here May Revolutionize World Scientific Theories". (See Vol. 14, No. 6, 1964, *The Garden Journal.)*

The summer's trip of more than thirteen thousand miles of driving was also highlighted by nonfossil activities, such as visiting several botanical and public gardens which no one who travels a similar route should miss. I refer to the Climatron at the Missouri Botanic Garden in St. Louis, to the Botanical Garden of the University of California in Berkeley, to the Butchart Gardens in Victoria and the Queen Elizabeth Garden in Vancouver, both in British Columbia.

The Climatron of the Missouri Botanical Garden is an advanced research and display greenhouse, the name implying the climate-control facilities of the structure. It is dome-shaped, seventy feet high, one hundred and seventy-five feet in diameter, and covers over one-half acre. The framework is of aluminum tubing lined by a layer of "Plexiglass." Air circulating systems with temperature and moisture control are automatically programmed and put into operation according to need. A raised balcony around part of the interior of the greenhouse permits visitors and gardeners a bird's-eye view of many tropical plants which could never be duplicated in an ordinary greenhouse. There is an Amazonian forest, a pool for aquatics, a bog area, and a Hawaiian section, all with a daily temperature and moisture gradient paralleling that of the native habitats of the plants.

Botanical gardens in Europe are usually associated with universities. In the United States this is not always so, but several universities find it expedient to use botanical gardens as research centers for their botany departments and, incidentally, open them to the public. The University of California has done just that, developing a fascinating natural setting on the steeply terraced and sloping Berkeley Hills. Berkeley's climate favors especially the cultivation of western trees and shrubs, of plants from the Mediterranean and the Near East, from Australia, New Zealand, and South America.

A large segment of the Garden is devoted to our western cacti and succulents, and to xeric plants from South Africa. They are effectively and naturally placed with a colorful array of flowers throughout the year. A panoramic backdrop of San Francisco Bay with the Golden Gate and Oakland Bay Bridges enhances the effect.



The hood of a cobra plant, *Darlingtonia californica,* in its native habitat near Coos Bay, Oregon. This insectivore is related to the eastern pitcher plant, *Sarracenia.*

This cone-bearing branch of the fossil redwood, *Sequoia affinis,* from Grant, Montana, is twenty-five to thirty million years old, but almost identical to the living species.

Since this is not a travelogue, I shall forego descriptions of the incomparable Oregon coast, the volcanic peaks, the redwood forests, the rain forest, the mountains of the Olympic Peninsula, and the splendor of the Canadian Rockies. I cannot refrain, however, from calling attention to a large stand of *Darlingtonia,* the cobra plant, near Coos Bay, Oregon. This tall and slender pitcher-plant with a translucent, dome-shaped head, is one of the remaining rare insectivores of our West Coast. It occupies here an acre or more of bog along the highway and is conveniently accessible via a solid boardwalk. It is reassuring to know that only about fifteen per cent of Oregon's coastline is in private hands.

Ferry service from Port Angeles, Washington, across the Strait of Juan de Fuca to Victoria, British Columbia, on Vancouver Island, offers a brief sea voyage in usually choppy and churning waters which carry enormous kelp torn loose by the currents. Victoria is a charming city of European flavor, with gardens and flowers, public windowboxes and hanging baskets, and formal, well-tended beds with a profusion of bloom and color. No visitor can miss the signs which direct him to the Butchart Gardens, comparable perhaps, but surpassing in scope and splendour the Sterling Forest Gardens in Tuxedo, New York.

The Gardens were created from twenty-five acres of an exhausted limestone quarry of Mr. Butchart's cement enterprise. (See *The Garden Journal,* Vol. 1, No. 1, 1951.) By skillful use of large excavations, of remaining walls and other contours, harmoniously landscaped units were created which grade and blend one into the other. A sunken garden with pools and fountains appropriately forms the center of attraction, but is equaled by the large expanses of a perennial garden, a rose garden, a formal Italian, and a unique Japanese garden bordering on a forested bay. Annuals and perennials are planted for mass effect, and the positively weedless lawns are the finest I have ever seen. Tuberous begonias of all colors, suspended in hanging baskets with flowers

up to ten inches in diameter, are breath-taking. Only color photos could convey the magnificence of the displays and the exquisite taste of the Garden's creators.

Another ferry ride from Nanaimo on Vancouver Island takes the traveler thirty-five miles across the Strait of Georgia to Horseshoe Bay, a few miles northeast of Vancouver. This ultra-modern city can be viewed best and appreciated most from Grouse Mountain in North Vancouver via a steep and fast sky-ride of one-half mile to the top in four and a half minutes. Vancouver boasts several scenic parks, but none excels Queen Elizabeth Garden in beauty and location, if not in size. The Butchart sunken garden is repeated here on a small scale, but the Queen Elizabeth Garden has its own rock garden character with well-groomed pools. Giant gunnerras, the leaves of which may be compared with rhubarb, ten feet high and six to seven feet in diameter, are reflected in the water. In the distance, between unusual deciduous trees and evergreens, clean and gleaming skyscrapers fill the gaps with the lofty, bluish hazy mountains in the background. To do full justice to the Queen Elizabeth Garden, one should visit it before proceeding to Victoria and the Butchart establishment.

The sunken garden at Butchart's Garden in Victoria, British Columbia.

RHODODENDRON POISONING (from page 18)

classic investigation. Methods for the segregation of the compounds were given, their physical and chemical properties defined. Andromedotoxin was shown to produce paralysis, vomiting, dyspnea, and convulsions in dogs and, finally, death from respiratory failure. But most important of all, he observed the profound depression of blood pressure in a dog after being given small doses of andromedotoxin.

In a high voltage industrial society where hypertension has been a major medical problem. Dr. Archangelsky's challenging observations were inexplicably ignored. For nearly a quarter of a century no further investigations were carried out. Then a study was made by Dr. S. W. Hardikar at the Pharmacological Laboratory of the University of Edinburgh only to determine the action of the toxin which had poisoned livestock in Scotland. Dr. Hardikar was the first to isolate pure crystalline andromedotoxin. He described in detail how it depressed respiration, slowed the heart with an accompanying toxic action on it, paralyzed the skeletal muscles, and caused vomiting. Again, the provocative reduction in blood pressure was noted in his report.

In 1953 a group of investigators at the School of Medicine of Emory University in cooperation with The National Heart Institute, repeated the Hardikar experiments, this time largely on dogs. Although the results were much the same, the techniques were more sophisticated, and they were able to show that some of the effects were not caused in the manner suggested by Hardikar. The depression of blood pressure was studied intensively, and it was found that the fall in pressure was by no means due entirely to the slowing of the heart action. Thus, after a strange hiatus of sixty years, Dr. Archangelsky's observations of 1899 were on the threshold of contributing to mankind's welfare.

The door was now open, and a brilliant group of researchers at The National Institutes of Health entered it eagerly. Their first publication, *Andromedotoxin: A Potent Hypotensive Agent from Rhododendron Maximum,* described how a dose of andromedotoxin as small as one part in ten million, lowered the blood pressure of dogs by as much as forty per cent. The next paper showed exactly the site of effect in the circulatory system and proved that the action was entirely reflex in nature. At the same time, the structure of the andromedotoxin molecule was partially determined.

Two groups of researchers at Nagoya University and Okayama University in Japan made a critical contribution when they provided, in 1961, a structural formula for acetylandromedol, as it is now called. And finally, in 1962, an American investigator completed the long search when he determined in detail the stereochemical structure of the acetylandromedol molecule.

After twenty-four centuries of vicious affliction, the beautiful but baleful rhododendron is being converted from a bane to a benefit for mankind. With a model from nature of the acetylandromedol molecule, research chemists can now modify it for the relief of high blood pressure.

There is a footnote to this curious history. In 1949, a Turkish investigator discovered a method of detecting acetylandromedol in honey made from rhododendron nectar—injecting extracts of suspect honey into mice and guinea pigs. Their response to the poison confirms, in modern terms, the observations of Pliny, the great naturalist of the Roman Empire. The research was done in northern Turkey, near the shores of the Black Sea, at almost exactly the same place where the armies of Xenophon and Pompey had come to grief two thousand years and more before.

SIERRA GARDEN

By THOMAS H. JUKES

Dr. Jukes, a biological chemist, is associated with the Space Sciences Laboratory of the University of California, Berkeley. He has collaborated with the former Director of The New York Botanical Garden, Dr. William J. Robbins, and has contributed to "Conversations on Ecology" (*The Garden Journal,* Vol. 14, No. 5.)

FOR MANY OF US, wild flowers have an irresistible attraction which is quite remote from the pleasures of gardening. Perhaps the basis of this lies in the feeling that wild flowers are a part of our heritage as denizens of the earth. We feel, and correctly so, that all life shares a common origin. What could be more refreshing than the contemplation of beautiful living forms which have evolved and survived in their niche for many millions of years, independent of human cultivation, and in spite of man's efforts to change his environment to suit his own desires and whims?

It was with such thoughts in mind that I set forth from camp on a morning in August. My sleeping bag was beside Lake Ediza, at ninety-three hundred feet above sea level, a few miles south of the southeast boundary of Yosemite National Park. The spectacular peaks of the Ritter Range were a short distance to the west; they ended in a cluster of black pinnacles, the famous Minarets, whose jagged summits rise steeply above the small glaciers at timberline. Below the glaciers the scene was beautifully adorned with clumps of wild, shaggy hemlocks *(Tsuga mertensiana).* The roar of waterfalls filled the air; later, beside the creek, I heard the quiet song of John Muir's favorite bird, the water ouzel *(Cinclus mexicanus),* coming from a small cave beneath a rock which was wet with the spray from a cataract.

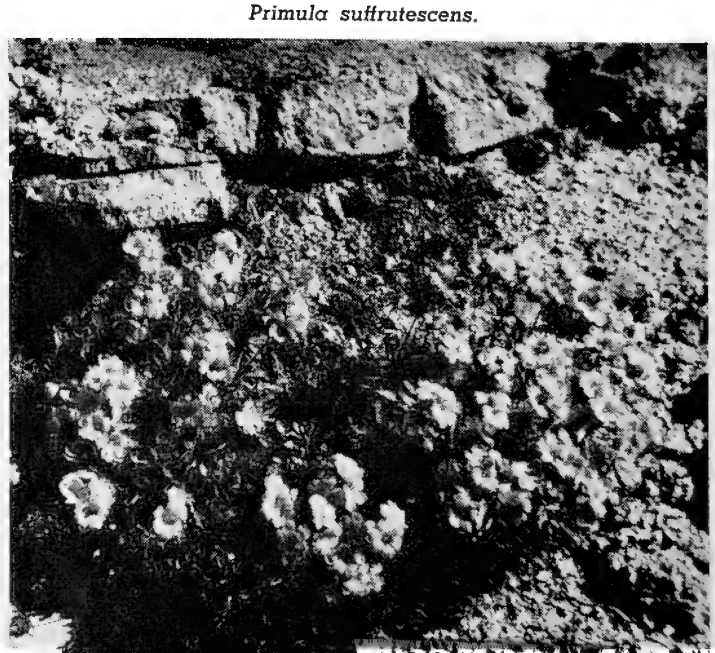
My way led steeply up the unnamed stream that starts in the snowbank on the west side of the saddle between Mount Ritter (13,157 feet) and Banner Peak (12,945 feet). It flows through one of my favorite Sierra gardens — one that I have visited, from time to time, ever since 1937.

The minarets, glaciers, hemlocks, *Tsuga mertensiana,* and Lake Ediza create a spectacular scene.

Saxifraga tolmiei.

Epilobium obcordata.

Primula suffrutescens.



Dodecatheon jeffreyi in a mountain garden.

A strong breeze stirred the splendid clumps of rose epilobium *(Epilobium obcordata)* which were luminous in the bright sunlight, among the scattered rocks. The lateness of the season had brought the tiny alpine gentian *(Gentiana newberryi)* into bloom throughout the rocky meadows, but the delicate white bells of *Cassiope mertensiana* and the red flowers of the bryanthus *(Phyllodoce breweri)* had faded to brown. Bushes of the Labrador tea *(Ledum groenlandicum)* were in bloom, and everywhere there were clumps of blue lupines. Higher I climbed, over the heaps of rough rocks among which were the blossoms and seed pods of alpine saxifrage. Many flowers greeted me: yellow potentilla, Indian paint-brush of varied hues, bog-laurel, the elfin harvest of the boreal zone. Rosy finches chattered, a Clark's crow scolded me, and a group of Brewers' blackbirds flew by, on their late summer vacation, rising and dipping in the strong wind.

My greatest reward came at the edge of a snowbank. It was still receding, and thus had given rise to a freakishly late spring for a few clumps of Sierra primrose *(Primula suffrutescens)*. Elsewhere it had long since gone to seed, but in this cold shelter its crimson flowers were fresh and brilliant.

I gazed at the great sweep of the ancient glacial cirque below me. By now I was above the scattered forest of lodgepole pine *(Pinus contorta latifolia)* and hemlock, up among the stunted mats of wind and snow-controlled whitebark pine *(Pinus albicaulis)*. Lake Ediza glittered beneath me in the distance; beyond it rose the peaks of the Volcanic Ridge, above them the dark blue sky with a few white, puffy cumulus clouds. Through the canyon of Shadow Creek I could see the distant haze of the Nevada desert in the east beyond Mono Lake.

I turned away and continued my ascent, up the cliff to the saddle and then up the loose, steep talus to the summit of Banner Peak for a superb view of the Sierra Crest. Far to the south, I knew, there were many more splendid gardens, unweeded, untrodden, hidden among the seemingly harsh rocks; high gardens of polemonium on Forester Pass; flower beds of shooting-stars *(Dodecatheon* sp.) in the upper basin of the Kings' River; the parklike glories of Evolution Valley; the small meadows in which *Draba* blooms, bright yellow beside Sapphire Lake; the ancient foxtail pines *(Pinus balfouriana)* of Tyndall Creek Basin; all glowing in the late summer sun before the snows of October would blanket the High Sierra for another long winter. Filled with these musings, I started to descend towards camp.

TRILLIUM NUMBERS

By RICHARD B. FISCHER

Dr. Fischer is Professor of Nature and Conservation Education at Cornell University, Ithaca, New York.

The following is based on an article which appeared in *Nature Study,* Vol. 20, No. 1, the publication of the American Nature Study Society.

THE GENUS *Trillium,* as every botany teacher likes to point out, gets its name from the fact that its flower parts as well as its leaves are arranged in threes. Found in woodsy habitats throughout temperate North America (and eastern Asia, too), it is a plant group familiar to many readers of *The Garden Journal.* John Burroughs conferred literary immortality on *Trillium grandiflorum* when he chose wake-robin or white trillium as the title of his first nature book.

In central New York where I commune with trilliums each spring, there are four species: *T. undulatum* (painted trillium), *T. erectum* (commonly called wake-robin, as well as stinking Benjamin, headache-plant, and other names suggesting its bad odor), *T. cernuum* (nodding trillium), and *T. grandiflorum.* The last-named is truly abundant. Now it is well known among outdoorsmen that occasionally something goes wrong in the trillium plant, resulting in a curious departure from the normal pattern of threes. To know this happens is one thing, to discover an example is quite another matter. And since forty eyes are better than two, I enlist the aid of my students in the quest of trilliums with the wrong numbers. When trilliums are blooming, I offer a reward —"bonus points"—to anyone who finds a freak. More often than not, no one claims the reward. However, the by-products of this careful searching are numerous: a group of bishop's-cap here, a dwarf ginsing there. Two of our finds are shown in the photographs.

The pure white flower belongs to *Trillium grandiflorum.* Since its pattern is fours rather than threes, I suppose one could call it a "Quadrillium." When I took the picture in 1964, there were two such flowers in a single clump of ten blooms. In 1965 I returned to the plant to get a better photo. To my astonishment, every blossom was normal. Puzzled, I spoke to Professor L. L. Pechumen, America's most noted student of this odd phenomenon. Although Dr. Pechumen is Curator of Cornell's entomology collections, he has studied tril-

Trillium grandiflorum, not in the normal pattern of three, but in a pattern of four.

liums for many years and has cultivated all but one of the world's species. He told me that my experience is not an unusual one, that botanists are not sure just what goes on, but it appears not to be genetic.

Although interested in my specimens, Dr. Pechumen

This aberrant specimen of *Trillium undulatum* has three sepals, four petals, and five leaves.

was not particularly impressed because, as he related, trilliums can diverge so far from normal that they may have a dozen or more petals, or many leaves and just a few petals, or no petals at all. Practically any combination of characters is possible. Furthermore, the more aberrant the flower, the more likely it is for that flower to persist as an oddity year after year. Dr. Pechumen has a potted specimen of *Trillium grandiflorum* which has green petals; chlorophyll being present, the flower remains on the plant well into August each year.

The photograph of the painted trillium is a good example of what Dr. Pechumen told me, for it has three sepals, four petals, and five leaves. I regret to report that the plant had disappeared when I returned to study it in 1966. However, I'm going back to the area, because there is a possibility of finding odd flowers again.

HUGGERMUGGER IN THE ORCHIDACEAE OR WHAT HAPPENED TO FIMBRIATA

By GEORGE A. ELBERT

Plant nomenclature is indeed a controversial subject as many, professional and amateur alike, are fully aware Here. the opinion of an amateur botanist is presented, and responses are invited from scholarly sources.

TAXONOMY, according to Webster, is the "Classification, esp. of animals and plants according to their natural relationships. . . ." Botanists spend a good part of their time with it, and the pitched battles of the science are generally most embittered (though polite) along this line. For us amateurs who have come so far as to prefer the systematic, Latinized nomenclature over the colloquial chaos, it is irritating to be faced with a choice between several authorities for the correct name of a plant. No sooner have we plumped for Professor X than Professor Y publishes a paper which obliges us to change all our records. Rebuttal follows rebuttal. In the end we are no longer sure of anything.

Botanists, themselves, are fully aware of the problem and indulge in rueful, half-humorous references. Largely bound by academic tradition, they make little attempt to find new solutions. Plants are exceedingly variable organisms, it must be admitted. However, this is hardly an excuse for disagreement, even at this late date, in regard to well-known and ancient families and genera. In 1933 Dr. J. K. Small *(Manual of Southeastern Flora)* called grasses *Poaceae* and in 1950 Gray's *Manual of Botany* used *Gramineae;* for Dr. Small the mints were *Lamiaceae* and in Gray's they were *Labiatae*. Examples

may be cited from many other works. With names of species, the situation often verges on the ludicrous.

Whenever there is a considerable amount of progressive variation within a genus (there are a number of types intermediate between extremes in respect to size, smoothness or roughness, hairiness, etc.), the taxonomist has a field day of name-making. One of the charms of the science is derived from a belief in having discovered something new. One of the rewards is the ability to append his name, or that of a revered colleague, alive or dead, to a newly discovered species. This is, of course, legitimate when new botanical territory is explored or a systematically differentiable form can be segregated. But most of the trouble takes place when well-worked-over material is re-evaluated.

The principal difficulties and confusions arise when, within one of the familiar genera, a taxonomist chooses to set up a new species. In order to do so he must of necessity deduct plants from the other, traditional, species which, he must argue, have been included in error. It would appear reasonable to demand of such changes the most precise kind of objective evidence. This is all the more important, since the segregation of a new species increases complication unless there is a true purpose in doing so. And this purpose is only likely to be found where the segregation clarifies the organic pattern of mutation or adaptation within the genus.

A prime example of the confusion which can be created by scholars in the simple world of the amateur naturalist is the taxonomic fate of the purple fringed orchid, a member of the genus *Habenaria.* It is one of the most beautiful of our wild flowers and deserves better treatment. Let us pursue the matter in some detail through two outstanding botanical works, Donovan Stewart Correll's famous *Native Orchids of North America* and Gray's *Manual of Botany* as expanded by Merritt Lyndon Fernald, hereinafter referred to as Correll and Fernald. Both of these works bear a 1950 copyright.

Fernald lists *Habenaria psycodes,* the small purple fringed orchid. Mentioned also under this heading is *forma albiflora* and two formae which have atrophied flowers. *Habenaria fimbriata* appears as the large purple fringed orchid. "Similar to No. 20 [*psycodes*], larger." Again *forma albiflora* is mentioned. Also "Hybridizes with No. 20 [*psycodes*] and perhaps with No. 18 [*H. lacera*]." "Several aberrant forms occur." (Quotes are from p. 474)

Correll recognizes *Habenaria psycodes.* Then he proceeds, "Much confusion has existed in the group of plants comprising the purple fringed orchids. One factor which has contributed greatly to the confusion is the apparent abundance of the hybrid *H. andrewsii.* Again, the separation of the small purple fringed orchid from the large purple fringed orchid proves to be simply an arbitrary procedure based on a difference in the size of the raceme and flowers—a most unsatisfactory criterion." (p. 87) Exit *fimbriata.* Enter *andrewsii.* He then proceeds to quote an exasperated fellow botanist on the subject. Let us see how Correll "simplifies."

Rather than assign to the "larger" *Habenaria psycodes* a separate species name (Fernald's *fimbriata*), Correll simply downgrades it to var. *grandiflora.* This is all to the good as long as no other criterion exists save comparative size. But on this page (99) he shows three drawings. One, called *H. psycodes,* is quite small, the two sepals and one petal being more or less ovate and the lip, which is three-lobed, rather evenly and superficially fringed. The other two drawings are at least twice as large. The two petals are a long oblong and the lip, with lobes more widely spaced, is shown as having a somewhat different and deeper laciniation.

I have noted the reference to *H. andrewsii,* which derives from an earlier monograph. This newcomer is a "putative" hybrid between *H. psycodes* and *H. lacera.* Putative, a lovely word, means generally considered, reckoned to be—a most extraordinary definition for a scientific adjective. For the existence of this hybrid no evidence is presented. It has never been produced experimentally. It is, indeed, putative.

It is well known that orchids have looser morals than other flowers and that hybridization is carried on shamelessly in the wild. Correll, however, presumes with his hybrid to account for most, if not all the variations from the normal in the purple fringed orchid which are not covered by his *H. psycodes* var. *grandiflora.* Is it any wonder if the student's head begins to spin at this point?

The child of this mesalliance of *H. lacera* and *H. psycodes* is supposed to resemble sometimes one, sometimes the other parent. Now *H. lacera* is, itself, a variable and attractive orchid. Its petals and sepals are inconspicuous, while its lip is most prominent and is divided into three lobes whose segments are reduced to lengthy threads. The color varies from straw to white. It prefers sunny locations in open meadows and will even grow in a bit of sphagnum in sand along the coast (Fenwick Island, Maryland). The purple fringed orchid, on the other hand, is usually found in shady, boggy places in muck. The color normally varies from glowing pink to purplish. The chief differences offered by *H. andrewsii* are a more laciniate lip and petals and sepals which are a longer oblong than in var. *grandiflora.* I must ask the question, if var. *grandiflora* is so much more laciniate than simple *H. psycodes,* why is it not a hybrid? How can one be so precise in drawing the line? The quality of Correll's hybrid is, indeed, somewhat strained.

I have photographed the purple fringed orchid on only five occasions. Here are some details.

1. In one of the higher regions of the Skyline Drive, Virginia. Leaves coarse and broad. Raceme short, oblong, and crowded. Flowers one and one half times the width of the specimens below; sepals and petals rounded and lip evenly fringed. Color a very light pink with a whitish yellow eye. Correll's and Fernald's *H. psycodes* without a doubt. Except—it is relatively much too big.

2. From a wet wood north of Sacondaga Reservoir, New York. Two feet high with narrow leaves and a few-flowered, pyramidal raceme. Flowers purest glowing pink; sepals and petals distinctly rounded exactly as in Correll's drawing of *H. psycodes,* but laciniation precisely as in *H. andrewsii.*

3. From near Canaan, Connecticut. Over four feet

high. Leaves narrow. Raceme oblong and excessively crowded. Flowers pink, fringed as in var. *grandiflora;* petals and sepals definitely rounded, not oblong.

4. Another very tall plant from Massachusetts. Very long, pyramidal raceme, not crowded. The distinguishing feature was the floral bracts, twice the length of the very pink flowers and very prominently projected.

5. Near Taconic, New York. About three feet high. The raceme a long oblong. Flowers loosely packed, sepals and petals oblong and rather deeply fringed, color deep purple. Laciniation like that of var. *grandiflora.*

The above listing proves nothing except the enormous variability of the purple fringed orchid. There are several features which do not fit into any of the categories set up by Correll. None of these plants bears any apparent relation to *H. lacera.* Certainly none of that parent was growing nearby. A good case could be made for the segregation of a form with much laciniate lip and rounded petals and sepals—a type Correll apparently forgot.

Whether we accept *H. fimbriata* or var. *grandiflora,* or × *Habenaria andrewsii* depends simply on our relative respect for the authority of Fernald or Correll. Neither of the listing methods is satisfactory in describing the material. I should like to suggest a solution which is more realistic and considerably more helpful.

Habenaria psycodes is the old name for the purple fringed orchid, and that should be the name of the species and no other. I have seen how variable this plant is. How can one make two species where there is one? The description of the species should be the broadest possible in terms of measurement and shape. Gradations between fringed lips and deeply laciniate lips and their combinations with more or less rounded petals and sepals can be catalogued as *forma,* using appropriate Latin adjectives. A cataloguing of *forma* would be little more than a demonstration of the most frequently occurring types within the form range of the plant. For amateur and specialist alike, this would represent a great improvement in ease of identification. Atrophied and regressive forms need only be mentioned in text since they are few in number.

In this way the unity of the species would be preserved, the basic names standardized, and the types made recognizable. Drawings of the agreed *forma* would be most helpful. Hybrids should only be mentioned as possibilities until experimentally proved. Further study of the species may give cause for a different partition, but it would be better to let it come as a result of the observation of specific causative relationships.

That which is true of *Habenaria psycodes* applies equally to many other species causing confusion even among professional botanists. It would be a pleasure to see the scientists agreeing to certain fixed designations among the variable plants. Even a body like our Congress occasionally makes a law.

BOTANICAL NAMES

By HAROLD WILLIAM RICKETT

Dr. Rickett is Senior Curator of Botany at The New York Botanical Garden.

A certain publisher, contemplating the first proof of plates in our *Wild Flowers of the United States,* said, "But no one can sell a book with the pictures labeled with those Latin names; you must replace them with the English names." Various other persons have evinced the same fear of or downright hostility to the botanical names of plants. This seems to be a peculiarly American phenomenon. In Europe people take it for granted that plants must have scientific names; I learned them, as a boy, from my father who had no Latin or botany in school (and very little schooling). But here a widespread feeling exists that these names are only for scientists' use and unintelligible to the layman; part of the "mystery" of science. "Latin!" says the publisher, "Why should we use a dead language? Let's name things in our own language!"

Well, perhaps they *are* unintelligible—to persons who shun education and the free use of the intellect—who are in fact semiliterate. The arguments for the Latin names are well known; the English names are applied indiscriminately and confusingly, one name to several different kinds of plants, and many names to one kind; and most of our many thousand native plants have never received any English names, being known only to botanists and the more enthusiastic and knowledgeable amateurs. I shall not take time here to give examples—read the introduction to one of our "wild flower" books. But there is one point which seems not to occur to our anti-intellectuals: if they garden, they are themselves using Latin names! The nursery catalogues spout them on every page, and the publisher quoted above probably mouthed them whenever he bought plants. Scan the following list. Most of the names therein are familiar to you; they are also the botanical names of plants.

Abelia	Coleus	Narcissus
Acacia	Cosmos	Nasturtium
Acanthus	Cotoneaster	Nemesia
Agave	Crocus	Nicotiana
Ageratum	Dahlia	Petunia
Aloe	Delphinium	Phlox
Alyssum	Dianthus	Rhododendron
Amaryllis	Freesia	Salvia
Anemone	Fuchsia	Scabiosa
Artemisia	Gaillardia	Sedum
Aster	Geranium	Spiraea
Aubrieta	Gladiolus	Syringa
Azalea	Hydrangea	Verbena
Begonia	Iris	Veronica
Calendula	Lobelia	Viola
Cattleya	Magnolia	Weigela
Chrysanthemum	Mimosa	Yucca
Clematis	Mirabilis	Zinnia

There are doubtless many others. And there are also botanical names which so closely resemble English names that they can scarcely be incomprehensible by the most inactive intelligence: *Coffea, Cucumis, Cupressus, Hyacinthus, Juniperus, Laurus, Lavandula, Lilium, Lupinus, Orchis, Pinus, Prunus, Rosa, Saxifraga, Spinacea.* A few, unfortunately, are misapplied: *Geranium* does not refer to the household plant commonly so named (botanically it is *Pelargonium*); *Nasturtium* is the name of water-cress, not the well-known garden flower; *Syringa* is, botanically, the lilac, not the mock-orange; *Alyssum* is also misused; *Azalea* is no longer a separate kind of plant (they are all *Rhododendron* now). But *as words* these names offer no difficulty; from Latin they have passed into English.

The names in the above lists are the names of kinds of plants *in the broad sense,* what the botanist calls *genera. Lilium* means all true lilies; *Begonia* is the name of tuberous begonias, Rex begonias, and all the rest; *Iris* includes many species, varieties, and hybrids; and so on through the list. The individual *species* within each genus are, necessarily, named in a slightly more complicated fashion, which may indeed offer some difficulty to the unscientific person. Linnaeus, father of our botanical nomenclature, faced with several species of roses, named them "red rose," "white rose," and so on; but, since Latin was then the language of scholars and clerics, he wrote these names as *Rosa rubra, Rosa alba,* etc. (the adjective following the noun). This is in essence the system we still use: the name of a species is *two words,* of which the first is the name of the genus to which it belongs. The second may be a descriptive adjective, as "alba," or it may commemorate the person who discovered it *(Aster blakei)* or the region where it was first observed *(Iris virginica).* These names may, at first sight, look formidable, but they surely offer no insuperable obstacle to an average intelligence. They certainly do not warrant the complaint of one correspondent (and only one) that the plants in our first volume were designated by "meaningless" Latin names! They have more meaning the more you use them.

Some botanists, indeed, catering to those who would insist on English names, have invented them, or translated the Latin into English; and so we have Asa Gray's lily instead of *Lilium grayi,* Drummond's skullcap for *Scutellaria drummondii,* and downy ragged goldenrod for *Solidago petiolaris.* Are these any easier to use, or more meaningful? Or are we not simply turning our backs on science?

Many years ago Linnaeus wrote (in Latin, of course), "If you don't know the name of a thing, the knowledge of it perishes also." This is as true of plants as of all other objects in our fortunately heterogeneous world. And to name plants in a useful way we must have a stable sort of system, immune to the mutability of the vernacular and the chance resemblances of unrelated species, and expansible enough to provide, without difficulty, for the several hundred thousand species we know. This we have achieved, by the beautifully simple and precise system of botanical nomenclature.

Tudor children were sent out by their parents to collect wild rose hips for homely medicines. But today's harvesters—thousands of school children in the North and in Scotland—pick the crop from the wild hedgerows for extra pocket money.

This scene was taken on the banks of the River Warisbeck near Newcastle upon Tyne. Pupils at Seaton Brown County School, Wideepen, pour the rose hips they have collected on to a tarpaulin for weighing.

After the rose of midsummer fades, the red fruit yields a rich harvest in Vitamin C and is used for rose hip syrup. The three species richest in this vitamin are the wild dog rose, *Rosa canina, R. mollis,* and *R. shiradii.* Since the last war, when a scheme for voluntary paid harvesting was devised, the young collectors have gone on "hipping" . . . Hundreds of tons are picked every autumn. The children are paid by the pound, and the school, which usually acts as the weighing and dispatching depot, receives an additional payment a pound for its amenities fund.

Some schools appoint a "King" or "Queen Hip" to supervise the depot operations; others have rose hip clubs with a merit badge for the child with the most poundage, and, of course, the most rose hip money in his pocket.

Reprinted from *The Times,* October 3, 1966, London, England

COURSES, LECTURES, AND OTHER GARDEN EVENTS

(For detailed information about a particular event or course, write or phone 584-8500)

ILLUSTRATED LECTURES SPONSORED BY THE WOMEN'S COUNCIL—4 Thursdays at 11 a.m., beginning January 5, 1967—at the Cosmopolitan Club, 139 E. 65th Street, New York.

EVERGREEN TREES AND SHRUBS (8 sessions)—Saturday morning class 10 a.m.-12 noon. Starts January 7, 1967. Instructor—Eleanor Yarrow.

ADVANCED BOTANY II (4 sessions)—Monday evening class, 8-9:30 p.m. Starts January 9, 1967. Instructor—Dr. H. N. Moldenke.

ARTIFICIAL LIGHT GARDENING (3 sessions)—Tuesday evening class, 8-9:30 p.m. Starts January 10, 1967. Instructors—Mr. and Mrs. Alfred Katzenberger.

LANDSCAPE GARDENING, winter term (7 sessions)—First-year students: evening class Tuesday, 8-10. Starts January 17, 1967. Second-year students: Thursday evening class, 8-10. Starts January 19, 1967. Instructor—A. F. Murphy.

HOUSE PLANT SHOW IN THE CONSERVATORY—January 21-March 5, 1967.

PLANT PESTS AND DISEASES (8 sessions)—Thursday morning class, 10-11:30; Thursday evening class, 8-9:30. Starts February 2, 1967. Instructor—Dr. P. P. Pirone.

PREHISTORIC BOTANY, PLANT FOSSILS (3 sessions)—Tuesday morning class, 10-11:30; Tuesday evening class, 8-9:30. Starts February 7, 1967. Instructor—Dr. Herman F. Becker.

"A VISIT TO FANTASTIC HAITI"—illustrated Saturday Afternoon Lecture by Mavis Swyers on February 18, 1967 at 3:15 p.m.

"ENGLAND THROUGH THE EYES OF A NEW ENGLANDER"—illustrated Saturday Afternoon Lecture by Elizabeth C. Hall on February 25, 1967 at 3:15 p.m.

PLACES TO STUDY PLANTS AND GARDENS. (In-Service Course for Teachers) (15 sessions)—Wednesday afternoon class, 3:45-5:25 p.m. Starts March 1, 1967.

GARDEN DESIGN (6 sessions)—Wednesday mornings, 10-12 noon. Starts March 1, 1967. Instructor—A. F. Murphy.

CHILDREN'S OUTDOOR GARDENCRAFT. Starts March 4. Saturdays 9:30-12 noon until the close of the school year; then two weekday mornings during summer. Instructors—Lillian Weber, Nancy Callaghan, Hetty Everett, Agnes Faithorn, Anthony J. Galella.

"GARDENS AND FLOWERS OF THE PACIFIC NORTHWEST"—illustrated Saturday Afternoon Lecture by Dr. Herman F. Becker on March 4, 1967 at 3:15 p.m.

CRYPTOGAMIC BOTANY (8 sessions)—Monday morning class, 10-11:30; Monday evening class 8-9:30. Starts March 6, 1967. Instructor—Dr. Clark T. Rogerson.

"ERIN GO BRAGH"—illustrated Saturday Afternoon Lecture by Anne Neylon on March 11, 1967 at 3:15 p.m.

LANDSCAPE GARDENING, SPRING TERM (7 sessions)—First-year students—Tuesdays, 8-10 p.m. Starts March 14, 1967. Second-year students—Thursdays, 8-10 p.m. Starts March 16, 1967.

Members' Evening, March 30, 1967, at the Hotel Biltmore, New York City.

NEWS, NOTES, and COMMENTS

A Horticultural Exploration of Holland, Belgium and Germany. The second exploration of foreign horticultural and botanical institutions, sponsored by The New York Botanical Garden as a service to horticulture, will be to Holland, Belgium, West Germany, and London.

The trip projected for May, 1967, will provide for meeting directors, principals, and staff members of the leading horticultural institutions—botanical gardens, parks, private and public gardens, estates, schools, universities, nurseries, and shows. In arranging the itinerary, every effort is being made to vary the visits and permit a practical coverage of the many aspects of horticulture in these countries.

The itinerary is tentatively arranged for four days in Holland, three days in Belgium, ten days in West Germany, and the remaining four days in London, in time for the famous Chelsea Flower Show.

Here is an unique opportunity for staff members of botanical gardens, educational institutions, parks and horticultural organizations, nurserymen, and others keenly interested in cultivated plants. Several institutions supported staff members on the previous exploration; the practice is recommended for this and future trips.

The leader of the group will be Thomas H. Everett, Assistant Director (Horticulture) and Senior Curator of Education. The co-leader will be Henry Teuscher, former Curator of the Montreal Botanical Garden, Quebec.

Departure date via scheduled jet flight from New York—May 3, 1967.

Return date via scheduled jet flight from London—May 24, 1967.

The subscription rate is expected to be $1,050 per person (based on double rooms).

The trip will be limited to the number

John Jennings, retired detective lieutenant of the 52nd Squad of the New York City Police Department, is now Security Officer at The New York Botanical Garden. He is shown here with the day shift of the Botanical Garden attendants, and two of the trained German shepherd dogs which also guard the premises. Mr. Jennings, who is under the supervision of Richard J. Brown, Superintendent of Buildings and Grounds, directs a force of forty attendants who rotate on an eight-hour schedule seven days a week.

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that can be accommodated in one medium-size coach so that the group will not be unwieldy. Subscribers may extend their stay in Europe subject to revised higher air rates. Preference will be given to initial inquirers and reservations.

Please communicate with Thomas H. Everett, The New York Botanical Garden, Bronx, New York 10458, for the detailed itinerary and any other facts desired.

The New York Botanical Garden joined the Elementary School Science Association of New York in its 1966 Fall Conference with an exhibit on "Education at The New York Botanical Garden," at the Hotel Statler-Hilton on November 5, 1966.

The theme of the Conference was "Tomorrow's Environment—Havoc or Haven." Slides of children's activities at The New York Botanical Garden, bottle gardening, a film on how to pot a plant, a film on bean germination in time-lapse photography, and the *Wild Flowers of the United States* were exhibited.

The New York Botanical Garden's Education Department, headed by Thomas H. Everett, Assistant Director (Horticulture), has been offering courses for children since the spring of 1956.

Activities of Director and Staff. Dr. William Steere, Director, attended the meetings of the American Association for the Advancement of Science, held in Washington, D. C. December 26-30, 1966. He also attended the annual meeting of the Women's Council of The New York Botanical Garden on December 7, 1966.

Under Dr. Steere's grant from the National Science Foundation, Guy Erassard from Queens University at Kingston, Ontario, is spending a year at the Garden as his full-time research assistant on Arctic bryophytes.

Dr. Pierre Dansereau, Senior Curator and Head, Department of Ecology, attended the Centennial Celebrations of the Yale Peabody Museum, October 26-28, 1966. He participated in the "Symposium on Ethnobotany," presenting a paper entitled "An Outline of Ethnoecology: the Landscape and the Inscape." He attended the thirteenth annual Systematic Symposium at the Missouri Botanical Garden, October 14-15, 1966, and chaired the Botany Section of the "Symposium on Systematics and Natural Areas." Dr. Dansereau also participated in the symposium entitled "Après cent ans de sciences . . ." sponsored by the Association des Jeunes Scientifiques on the occasion of their fourth annual meeting, November 18-20, 1966, at Montreal, Canada.

Dr. P. P. Pirone, Senior Plant Pathologist, met with the Trustees of the Village of Pelham Manor on November 27, 1966, to aid them in formulating plans for curtailing the ravages of the Dutch elm disease among the remaining elms in the Village. He serves as a consultant on tree maintenance for the Village of Pelham Manor. As consultant to the U.N. on landscape maintenance, he recently visited its headquarters. Dr. Pirone presented an illustrated lecture on December 1, 1966, to the Men's Garden Club of New York; his subject, "Practical Solutions to your Gardening Problems."

Dr. Herman Becker, Curator of Paleobotany, was among the twenty paleobotanists from the eastern and central United States invited to attend the three-day symposium at Yale University in connection with the Centennial Celebrations of the Peabody Museum. Dr. Becker recently visited Princeton University to consult its paleobotanical collection.

Under a grant from the National Academy of Sciences, Dr. Tetsuo Koyama, Associate Curator, attended the Eleventh Pacific Science Congress held at Tokyo, Japan, from August 22-September 4, 1966. He read a paper entitled "Systematic Significance of Certain Morphological Observations in the Pacific *Cyperaceae*." As Secretary of the Association for Tropical Biology, Inc., he attended the meetings of Standing Committees related to biology and made, by invitation of the chairmen, a presentation of the Association for Tropical Biology, especially as to its organizational characters and the scope of its activities. Dr. Koyama also attended the symposium of the International Organization of Plant Biosystematists, held concurrently with the Pacific Science Congress.

As he was among the official delegates to the Congress, Dr. Koyama enjoyed the opportunity to be present at all the receptions, including the Imperial Reception by His Majesty the Emperor of Japan.

Before and after the Congress, Dr. Koyama made field works in southern Japan and Formosa to collect cytological and anatomical samples for his current research project.

On September 12, 1966, he lectured at the Faculty of Science, National Taiwan University on "The *Cyperaceae*, its Morphology and Classification."

Dr. Richard M. Klein, Alfred H. Caspary Curator of Plant Physiology, recently gave a biological colloquium on the "Effects of Light on Plant Growth" at the Department of Biology at Fordham University, New York City.

Dr. Harold Clum, Honorary Plant Physiologist, attended the annual meeting of the

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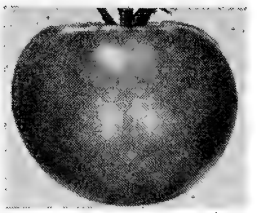

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Phytopathological Association held at Penn State University, University Park.

Seminars for Staff and Students of The New York Botanical Garden have been given on October 20, 1966, by Dr. Richard M. Klein, Alfred H. Caspary Curator of Plant Physiology, on "What's Wrong with Fluorescent Lamps"; and on November 17, 1966, by Dr. Nicholas T. Mirov, Research Associate Professor of the University of California at Berkeley, on "Geography of Pines."

The annual Christmas party, given by the President and the Board of Managers for employees of The New York Botanical Garden, was held in the Snuff Mill on the afternoon of December 20, 1966. An anniversary gift was presented to Ann Seaman for twenty-five years of service and retirement gifts to Dorothy Ebel Hansell and John Lyons.

Visitors to the Garden

Dr. Martha Springer of Willamette University, Salem, Oregon, spent a month at the Garden, studying the liverworts of Oregon.

Dr. Allan and Mrs. Ann Witztume, Cornell University, Ithaca, N. Y.

Dr. A. K. Bose, Stevens Institute of Technology, Hoboken, N. J.

Dr. H. Ohmi, Hakodate, Japan.

Dr. L. Hough, and H. Stiles, Rutgers The State University, New Brunswick, N.J.

Dr. Pierre Shaeffer, Institut Pasteur, Paris, France.

David Sutherland, Department of Botany, University of Washington, Seattle, Wash.

Dr. Robert Clausen, Wiegand Herbarium, Cornell University, Ithaca, N. Y.

Dr. Harold St. John, Bishop Museum, Honolulu, Hawaii.

W. D. Margadant, Hunt Botanical Library, Pittsburgh.

Dr. Calvin H. Heusser, American Geographical Society, New York.

Joyce Zavortink, Botany Department, University of California, Los Angeles.

Nancy Corre, Universidad de Guayaquil, Ecuador.

Jew-ming Chao, Taiwan Normal University, Taipei, Taiwan, China.

Dr. R. K. Godfrey, National Science Foundation, Washington, D. C.

Dr. A. E. Schuyler, Academy of Natural Sciences, Philadelphia.

BOOK REVIEWS

WILD FLOWERS OF THE UNITED STATES. Vol. 1, 2 parts. Rickett, Harold W. 569 pages, illustrated (color), indexed. McGraw-Hill Book Co., New York, N. Y. 1966. $39.50.

To the wild flower enthusiast this handsome publication comes as an answer to a prayer. What joy to know that any wild flower which grows in the Northeast can be identified through this book. Nearly twice as many species are described as in any previous work. End papers show the territory covered, from Maine south to Virginia and west to Minnesota and Missouri.

There have long been rumors of the ambitious program. It has, however, taken Dr. Harold William Rickett and a dedicated staff of specialists three years of intensive work to produce the present magnificent volume. It consists of 572 pages in two parts. Four other volumes will follow, the whole project covering the entire territory of the United States.

In the September-October issue of *The Garden Journal* the author modestly explains the steps necessary to producing such a masterpiece: "How to Write a Book about Wild Flowers." Starting with the design, he gives us a glimpse of the number of processes involved, the number of people concerned, the endless detail of text and plates, and the countless hours spent.

Over twelve hundred photographs in color are shown, most of them picturing plants growing in their native habitat. They are carefully placed six to eight on a page. The infinite care taken in selection and printing is well justified by the result. They are a delight to the eye as well as a pictorial dictionary. Some three hundred and fifty line drawings further assist in plant identification.

Dr. Rickett, Senior Curator of Botany at The New York Botanical Garden, is well known to hundreds of students of botany. He is author of a number of other books, including a classic on botany itself. Because of his wide teaching experience, he is equally at home with student and professional and is able to simplify the terminology of systemic botany so that technical language is kept to a minimum and common names are included. Pictures and text are conveniently adjacent to each other. Descriptions are meticulously exact and telling characteristics pointed out. But the writing itself is informal and not without an underlying vein of humor.

The book is dedicated to "David and Peggy Rockefeller without whose enthusiasm and generosity these books could not have been written, illustrated or published."

Dr. William C. Steere, Director of The New York Botanical Garden, who served as general editor of the project, writes an illuminating foreword.

Dr. Rickett, in his introduction, explains the best uses of the book.

The serious student is gratified to learn new facts, habitats and methods of identification. The nature lover will delight in seeing selections from nature unfold indoors, and the fireside reader will revel in the sheer beauty of the pages.

Opportunities for education and pleasure are enormously expanded with publication of this book.

HENRIETTA E. S. LOCKWOOD
Bedford, New York

OUTLINE OF MYCOLOGY. Langeron, M. and R. Vanbreuseghem. 426 pages, illustrated, indexed. Charles C. Thomas, Springfield, Ill. 1965 (rec'd. 1966). $16.50.

This is a translation by J. Wilkinson into English of the French work, *Précis de Mycologie.* It includes the first nine chapters of the second edition (1952) as revised by Vanbreuseghem. Essentially it is the same as the first edition (1945) by Langeron alone.

In contrast to American works on general mycology, which follow a scheme based on taxonomy, Langeron's work develops the subject based on morphology. Two brief chapters present Langeron's definition of the fungi, his arguments for including the fungi in the protista, and his more inclusive composition of fungi than is usually accepted. The actinomycetes and myxomycetes are considered to be fungi. Very brief characterizations of the major orders, families, and representative genera are given after a more or less traditional and conservative scheme. The major portion of the book covers morphology beginning with vegetative organs, then covering hyphal fusions, cytoplastic streaming, and reproductive and propagative structures. Other aspects covered are liberation and dispersal of spores and sexuality in fungi.

A certain unevenness in covering published research and in interpretation occurs throughout the book. One must keep in mind that much of the work covers information published before the 1940's and is now outdated by twenty or more years. Certain aspects, such as detailed descriptions of spore production particularly in imperfect fungi, based on research before 1945, are excellent and indicate that Langeron kept abreast with modern findings. In other aspects, such as classification and knowledge of life histories of some species used as examples, the information is much outdated even for 1945. A similar situation exists with the illustrations. Some, particularly those dealing with spore production, are from recently published works; others, including many dealing with general morphology, are taken from the older literature, and these, in some cases, are highly diagrammatic and inaccurate. The selection of species to illustrate various structures is well done; often the example is a human or animal pathogen.

As a reference book *Outline of Mycology* should be available to every professional mycologist. It certainly will be of great value when endeavoring to interpret the writings of the great number of French-speaking mycologists who have been influenced by Langeron and Vanbreuseghem. Conceivably the book might be useful as an adjunct reference book in a mycology course.

CLARK T. ROGERSON

INSECT PESTS. Fichter, George S. 160 pages, illustrated, indexed. Golden Press, New York, N. Y. 1966. Cloth $3.95, paper $1.00.

Here is one of the very best books for amateurs interested in identifying and controlling 350 of the common pests found in apartment and homes, on pets, in gardens and in woodlands. The illustrations in cloor by Nicholas Strekalovsky are especially outstanding.

P. P. PIRONE

A MONOGRAPH OF CANTHARELLOID FUNGI. Corner, E. J. H. 255 pages, illustrated (part color), indexed. Ann. Bot. Mem. 2. Oxford University Press, New York. 1966. $14.40.

Cantharelloid fungi are those whose fruiting bodies show characteristics intermediate between the thelephoraceous Basidiomycetes (those without gills, tubes, or teeth, and with an inferior hymenium) and the agaricaceous Basidiomycetes (those with gills). The hymenium in many species appears as ridges or gilllike folds; in others it is smooth. Among the best-known members are the chantrelles (*Cantharellus* spp.) and the horn of plenty *(Craterellus cornucopioides)* which are highly prized for food by the mycophagists.

In this monograph Dr. Corner has provided a detailed and technical account of eighteen genera, with many subgenera and sections, and some two hundred species, with many varieties and forms, of cantharelloid fungi. Microscopic detail is stressed throughout. An introductory section covers the problems of morphology, terminology, and taxonomy. Most of the book presents an illustrated (with line drawings) account of the species of the world. Keys to the identification of genera, species, and varieties are dispersed throughout the book. Five colored plates of Dr. Corner's excellent paintings, representing some thirty taxa, are included.

For the professional mycologist the monograph will be indispensable for the identification and understanding of the group. It will be less useful to the amateur mycologist, unless he has access to a microscope.

CLARK T. ROGERSON

SIZE AND CYCLE: AN ESSAY ON THE STRUCTURE OF BIOLOGY. Bonner, John Tyler. 219 pages. Illustrated, indexed. Princeton University Press, Princeton, New Jersey. 1965. $7.50.

In this book the author has set for himself "middle-sized questions," smaller ones being "unsatisfactory and sometimes trivial," larger ones becoming "remote from the facts." Most biologists strive similarly, but not always successfully, in their thinking and approach.

This volume is built upon the thesis that the life cycle is "the central unit in biology" rather than the adult organism. Development involves the structural changes in one life cycle, genetics the mechanisms between cycles, evolution the change in cycles through time. The adult is, after all, only one stage in the organism, even though it is often the main or only one considered.

By and large, length is used as a measure of size, and size is a function of time as well as of cell types. Successive chapters deal with the period of size increase, the period of size decrease, and the period of size equilibrium. Abrupt size decrease is effected by a portion of an organism, which gives rise ultimately to a new individual. This is in contrast to gradual decreases in size, associated with "senescence and decay."

Perhaps the most stimulating portion of this book is that which deals with evolution. The author rightly points out that the most successful type of life cycle, in both animals and plants, is that which has an extensive diploid and a short haploid phase. The total number of genes in the diploid gene pool is increased and works in favor of the diploid organism. Furthermore, there has been, from the Cambrian onward, an overall increase in size. To be sure, there have been size decreases, and certain organisms, such as the bacteria and blue-green algae, have remained relatively constant. However, the general trend of size increase is obvious, and the opposite is not normally found. The effect of size on the amount of variation is at present not clear.

In summary, the author concludes that organisms should be considered as life cycles, made up of a series of steps, with a minimum size—the cell, involving innovations—and a maximum size—development, involving reproduction. The life cycle is the hook which joins molecular and evolutionary events, and the author hopes that all biology may be pulled "together into one system."

This is a stimulating and provocative book. It requires reflection and analysis. It is not the kind of volume that may be read in leisurely fashion by the fireside on a cold winter evening.

EDWIN B. MATZKE
Columbia University
New York, New York

BRIEF NOTES ON RECENT BOOKS

GARDENS AND GARDENING

APHRODISIACS IN YOUR GARDEN. Connell, Charles. 143 pages, illustrated. Taplinger Publishing Co., New York, N. Y. 1966. $3.50.

Written for the male gardener, who also has an interest in amorous pursuits, this book humorously describes the selection

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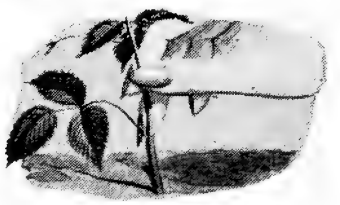

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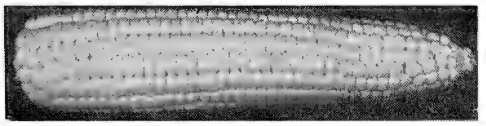

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and culture of plants which can be grown in gardens, either indoors or out, to which aphrodisiacal properties have been attributed. History, literature, and the medical lore of the early herbals are drawn upon, in tracing the very special properties of the plants herein described.

THE GARDEN: AN ILLUSTRATED HISTORY. Berrall, Julia S. 388 pages, illustrated (part color), indexed. Viking Press, New York, N. Y. 1966. $15.00.

This illustrated history of gardens and gardening deals with the gardens of ancient Egypt, the Middle East, Europe, America, and the Orient. The author relates the development of particular gardens to the social and cultural atmosphere of the time and place and also to the changes taking place within this environment. The work is copiously illustrated with reproductions of works of art, garden plans, and photographs. The quality of the illustrations is good.

JACQUES BOYCEAU AND THE FRENCH FORMAL GARDEN. Hazlehurst, Franklin Hamilton. 47 pages, illustrated, indexed. University of Georgia Press. Athens, Georgia. 1966. $7.50.

Dr. Hazlehurst, Head of the Division of Fine Arts at Vanderbilt University, here presents a serious study of the origins of the French garden, with considerable emphasis on the works and theories of Jacques Boyceau de la Barauderie. This is particularly important because there has been very little information available about M. Boyceau, who lived and working during the early seventeenth century.

The research upon which this volume is based, was carried out by Dr. Hazelhurst in 1953-1954, while he was studying in Paris as a Fulbright Scholar.

Accompanying the text are notes, a genealogy of Boyceau, excerpts from supporting documents, bibliography, and figures.

MISCELLANY

DAFFODILS ARE DANGEROUS. Creekmore, Hubert. 258 pages, illustrated, indexed. Walker and Company, New York, N. Y. 1966. $4.95.

Mr. Creekmore, author, poet, and critic, has gathered into this volume an interesting and readable account of poisonous plants common to gardens, both indoor and out. In alphabetic sequence he describes the more common plants and traces, through fact, folklore, history, and literature, the poisonous properties attributed to the particular plant. Many other plants are discussed in less detail within the text and can be traced through the index.

TAXONOMIC TERMINOLOGY OF THE HIGHER PLANTS. Featherly, H. I. 166 pages, bibliography. Hafner Publishing Co., New York, N. Y. 1965. $4.25.

This is a facsimile of the 1959 edition of a unique and useful reference.

TREES OF THE WEST IDENTIFIED AT A GLANCE. Rogers, Matilda. 126 pages, illustrated, indexed. The Ward Richie Press. Dist. by Lane Magazine and Book Company, Menlo Park, California. 1966. Hardcover $3.95, paperback $1.95.

This small volume provides a brief, nontechnical description of the "common cultivated trees any traveler will see in subtropical areas of the world." Each description is accompanied by a black-and-white or occasionally a color photograph, showing the most prominent identifying characteristic of the tree.

THE ARTISTIC ANATOMY OF TREES. Cole, Rex Vicat. 347 pages, illustrated, indexed. Dover, New York. 1965 rec'd in 1966. Cloth $4.50, paper $2.75.

This book, originally published in 1915 and now available in a reprint edition, is devoted to the description of trees from the artist's viewpoint. The work is in three parts: "Trees Considered in Relation to Painting," "The Anatomy of the Tree," and "The Details of the Tree." Each section is copiously illustrated. Although somewhat British in orientation, this book should be of interest to any student of nature in art.

LETTERS TO THE EDITOR

I make reference to an article, "Woody Plants of Summer Interest," which appeared in the July-August issue of *The Garden Journal.*

The bark of trees as a source of interest in a garden is often overlooked. Clarence E. Lewis recommends many trees which have beautiful barks. It is strange, however, that such trees should be recommended for summer interest. Surely, these are trees for winter.

During summer the bark is partially screened by leaves which at the same time distracts attention from it. In winter, with the leaves gone, there is only the bark to hold one's gaze. The colour is accentuated, perhaps because of the extra light which reaches it, but more likely because there is nothing else to create any distraction.

Under a winter sun, framed against a clear blue sky, any tree with handsome bark becomes a thing of beauty.

The issues of your magazine make interesting reading, for horticulture in all its aspects in other countries has great appeal for me.

BRIAN HALLIWELL
Edinburgh, Scotland

Trees or shrubs with colorful bark are not reserved for any one season of the year, winter or summer. You mentioned that the bark is reserved for winter; surely this is only a partial truth.

The bark is more noticeable in the winter because of the absence of leaves, but it is also interesting in the summer because of the shadows of the leaves complementing the mottled bark. The tree without interesting bark does not have as much summer attraction as the one which shows it for you to study. A partial glimpse of something is more intriguing than the full effect.

Your statement is true—"under a winter sun, framed against a clear blue sky, any tree with a handsome bark becomes a thing of beauty." This is also true if the shadows of a nearby tree cast their influence.

I was in your beautiful city for a week during late May and enjoyed the Botanical Garden, Princes Street, the Castle, and many other points of interest.

CLARENCE E. LEWIS
East Lansing, Mich.

I hope that the check I am enclosing is usable. Transfer of money from Ghana is almost impossible. I was about to use the check to buy a half-gallon of weed killer for a small farm I am trying to develop when the Garden's notice of my expiration of membership came. Weeds are the chief crop on the farm, and I guess they will be a while longer.

I have enjoyed *The Garden Journal* to the full and have shared its interesting articles with several people in Ghana. Several articles have been helpful, some have been intriguing, some delightful, and one I found particularly charming, "A Handful of Geraniums" by Gertrude S. Wister.

Mother John Cantius
Holy Child School
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MARCH/APRIL 1967

The Garden Journal

THE MAGAZINE ABOUT PLANTS · NON-TECHNICAL · SCIENTIFICALLY ACCURATE

Published by The New York Botanical Garden

A YEAR IN THE PLANALTO OF BRAZIL

FLOWER STAMPS FROM THE UNITED STATES

THE NATIVE PLANT GARDEN

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The Garden Journal

THE MAGAZINE ABOUT PLANTS NON-TECHNICAL • SCIENTIFICALLY ACCURATE

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Man thinks of himself as being able to control nature, but most of us do not understand the ramifications of our domineering activities outdoors.

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Extensive preparation of the soil and the atmosphere, and an understanding of the needs of each plant, assure congenial habitats for the many wildlings growing here.

ON THE FRONT COVER: The vastness of the Planalto of Brazil is emphasized dramatically by the tiny figures in the center of the picture. They are Dr. Howard S. Irwin, Associate Curator, The New York Botanical Garden, and his field assistant, Raimundo Souza, collecting plants on a steep waterlogged slope near Serra Dourada. Photograph by Thomas R. Soderstrom. Story on page 46.

ON THE BACK COVER: Drawings by Natalie H. Davis, from *Guide to the Native Plant Garden*. Story on page 76.

Elaine C. Cherry, Editor

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A YEAR IN THE PLANALTO OF BRAZIL

By HOWARD S. IRWIN

DR. IRWIN is Associate Curator at The New York Botanical Garden. He directs the Botanical Garden's exploration program in the Planalto.

Photography by Howard S. Irwin, John Grear, and Thomas R. Soderstrom

In the field, lunch is frankfurters and rice heated over a wind-protected crevice. Our cook, Raimundo Reis dos Santos, doubled as collector of grasses and sedges. All conversation in the field is in Portuguese.

Plant research, in all its diverse turns, is based upon a knowledge of the kinds of plants that exist. The world's greatest untouched botanical treasures lie in the interior of South America – but Brazilians are moving inland to occupy their remote hinterland. To prepare an inventory of living things in the Planalto, a naturalist must be one step behind the road-building bulldozers and one step ahead of the colonists. This is a plant hunter's adventure story of a year in Brazil's central highlands – the second field period of The New York Botanical Garden's Planalto Program.

AS OUR jet decelerated and began its long, circling descent on August 29, 1965, the sun shone through the plane's little circular windows but the city below was still dim in the pale light of dawn. My wife Marian and I shared thoughts at that moment: we were at the end of a smooth 8½-hour trip that had brought us 5000 miles southward from New York, a sharp contrast to our first South American flight 13 years before when we had spent 17 hours aboard a throbbing, island-hopping DC-4 bound for Georgetown, British Guiana. Of course, our daughters Dorothy and Elizabeth were not now the baby and toddler we had to care for and entertain back in those days. Still, our mood was one of marvel, heightened by the family's anticipation of a year of living and working in and around this newest of the world's cities, Brasília.

As we waited our turn with customs and immigration, I caught the scanning eyes of Raimundo Reis dos Santos. He smiled and called, "Bom dia, doutor, bom dia. Como vai?" I waved, then saw Raimundo Souza there, too. I had known the two Raimundos for five years; they were my field assistants on the Botanical Garden's expedition to the Rio Oiapoque in 1960 and to the Rio Jarí in 1961 (both rivers drain northern Brazil's Territôrio do Amapá). From them I had begun to learn the Portuguese that, away from my family, I used almost exclusively in Brazil. The two men had also spent five months with me in 1964 during the first field period of the Planalto Program during which we made nearly 3000 collections, mostly from the southern part of the interior state of Goiás. Both are skilled and experienced plant collectors: they were trained by today's foremost botanist of the Amazon, Dr. João Murça Pires, and are steadily employed on botanical expeditions in that great river system. The taller, Raimundo Reis dos Santos, is also a first rate though somewhat reluctant camp cook. The smaller, known to all as Raimundinho, is the most skillful tree-climbing plant collector in Brazil. The three of us, joined later by John Grear, graduate student from the Botanical Garden, and assisted by Sidney de Fonseca, driver-mechanic from our host institution, the University of Brasília, made up a party that spent an entire year in Brazil's vast cen-

tral highlands collecting herbarium specimens and other plant research material. At the end of our year in the Planalto, our New York-bound shipment weighed nearly 3½ tons!

Why the Planalto?

I first visited the Planalto in 1955 and was overwhelmed by the richness of the flora in the endless fields and scrub woods, in the thickly wooded creek borders and squelchy bogs. Although I had lived and traveled widely in British Guiana (now Guyana), here in the campos (open fields) and cerrados (scrubland) everything was different. It was as exciting as the trips I had made earlier to Kaieteur Falls in Guyana and Mount Roraima near the junction of the boundaries of Brazil, Venezuela, and Guyana.

In the winter of 1958-1959, when I was a graduate student at the University of Texas, I received a second opportunity to visit the Planalto. I needed more specimens and information to complete my doctoral thesis, a study of a species-group in the big leguminous genus *Cassia*. With borrowed money, the loan of a jeep from the Minas Gerais Department of Agriculture, and generous help from the Minas Gerais state agricultural school, I made a 2500-mile collecting trip in Minas Gerais and southern Goiás, returning through Brasília in the new Federal District.

As a student of the plants of the central highlands, or Planalto, of Brazil, I had long wanted to undertake a plant collection program and distribute well-prepared specimens widely in support of monographic and floristic studies. I wanted to see the many Brazilian species of *Cassia* in their native habitats and gather specimen material for my own continuing studies of this genus. I wanted to see the change of seasons – the regular shift from the dusty droughty months to the very wet humid season and the transition back again. Confusion has arisen from the changes in appearance that plants undergo according to the availability of water. Collectors sally forth far less often in the wet months, and plants flowering at such times are poorly represented in our herbarium collections.

After The New York Botanical Garden's years of concentrated exploration in the Caribbean area, the Guayana Highlands, and the Guianas, the Planalto of Brazil was the logical next step. Support for the Planalto Program is provided by the National Science Foundation, coincident with that given to another of the Botanical Garden's new exploration programs, the Upper Amazon Program under the direction of Dr. Ghillean T. Prance. The botany department of the University of Brasília is the host institution for the Planalto Program.

A Day in the Field

The nature of the work of a botanical expedition and the way in which this work is done are determined by many factors. It would be colorfully melodramatic to paint a picture of hardship and danger

The Planalto of Brazil is a vast plateau 1500 to 3000 feet above sea level, dissected by the headwaters of three river systems. Grassy campos and scrubby cerrados prevail, with tall trees found only in valleys near water.

– of snakes, jaguars, tarantulas, malaria, Indians, bandits, and floods – all existent but not really today's problems. In the Planalto, perhaps more than in any region that The New York Botanical Garden has sought to explore, field work is influenced more by the plants themselves and less by the constraints of supply lines, geographical barriers, human endurance, and other non-botanical matters. In practical terms, this means that we get about quickly in road vehicles, need spend no time hunting or fishing to supplement our food supply, and move from one campsite to the next as soon as the local sampling seems complete. Even more significantly, we can very nearly systematize our sampling of the flora, in both time and space. During the 1965-1966 field year, nearly half of our collecting sites were revisited, some three times, at intervals of several months.

Join us in the field and see the kinds of work carried out, the skills required, the hardships encountered, and the pleasures experienced. In mid-January 1966 when Marian and the girls were on summer vacation from school, we all set off for a week at Serra Dourada, a 3000-foot-high ridge running southwest-northeast in the southwestern corner of Goiás. (John Grear, our participating graduate student, was still in New York.) Before we left Brasília, we learned that there was a road to the top of Serra Dourada, used regularly by the trucks of a mining company. This was good news; despite our eagerness to make the trip, we wanted to be sure that we could get to the top.

We departed at dawn in our two field vehicles; we Irwins occupied our Brazilian-made jeep wagon, Sidney and the two Raimundos manned the specially made school bus that we had imported from the United States. The bus is our transport vehicle, storehouse, emergency laboratory, and occasional dormitory; seats out, springs stiffened, all mechanical parts oversized yet replaceable in Brazil, it has been the key to our mobility. We had registered the bus in the name of the university and lettered the nameplate "Mobile Botanical Laboratory," and were waved past customs guards and police at state borders and other check points. For the Dourada trip we loaded the bus with a week's supply of food, 100 gallons of spare gasoline and kerosene, four tents, cots for seven, two large tarpaulins, a complete field kitchen in four boxes, and all our equipment for collecting, pressing, drying, and packaging plant specimens.

About 150 of the 200 miles between Brasília and Serra Dourada are paved. The last 50-mile stretch is unsurfaced and took half of our one-day travel time. Despite the slow progress along ruts and around crater-like potholes, both vehicles made it without serious miring or wheel spinning. We inquired in several little villages about intersections, and saw Serra Dourada as we came over the summit of a hill. An hour later we reached the wooded

Camp pitched near sandstone summit of Serra Dourada. Three tents are dormitories, one is for supplies. Larger tarpaulin covers work area, smaller the kitchen and dining area. Distant derelict shacks belong to a mining company.

base of the steep slopes. Sidney and I realized at once that the loaded bus could not negotiate the seemingly vertical ascent. It occurred to us at that moment that the mining trucks always went up the grade empty and descended loaded! Sidney joined the family in the jeep wagon; geared down to compound low and four-wheel drive, the car crept up along two miles of switchbacks to the flat rocky summit. It was late afternoon, so we quickly selected a campsite near a rivulet and unloaded the wagon. Marian and the girls stayed to choose the best position for the tents while Sidney and I drove back to the bus for a load of gear. Raimundo was ready with the kitchen which we pushed into the wagon; then we loaded the tents and tarps.

Sidney and Raimundinho stayed with the bus to prepare the next load. Raimundo and I took the jeep wagon on its second trip up the slope, wincing as it labored and groaned and the temperature gauge rose. At the campsite Raimundo set up his kitchen and I drove back down to the bus to take on plant presses and other collecting supplies which Raimundinho helped me load. Then, with Sidney driving the much-lightened bus behind us, we ground our way into the fiery sunset, up to the top of Serra Dourada and a week of work.

By the time we pulled up to the campsite, Marian and the girls had recalled their Girl Scout training, had set up the kitchen, and even had bean-and-beef stew (feijoada) bubbling in a pot. With vehicle engines running, we played the headlights on the darkening campsite and helped Raimundo finish putting up the tents. Then came the two big tarps, one over the kitchen-dining area, the other over our work space. By 9 p.m. we had eaten, bathed, and arranged our presses, stoves, and other collecting and drying supplies in the

José Ramos, a young climber employed for the Royal Society party, removes a specimen of *Epiphyllum*, an epiphytic cactus, from a gnarled corky-barked cerrado tree.

work area. It had been a long hard travel day and we were ready to turn in. The lights of the little town of Goiás Velha, until thirty years ago the capital of the state, flickered ten miles away, deep in the valley of the Rio Vermelho.

Morning

For the rest of the week at Dourada, our days followed a pattern. In the morning, after breakfast of oatmeal and coffee, Marian, Elizabeth, and Dorothy set off in the dew-drenched grass with killing bottles and nets to find more insects for their collection. Later, as the sun rose and the temperature soared, the ladies would cool off in the little creek nearby. Raimundo, Raimundinho, Sidney, and I loaded our field presses, machetes, shovel, shears, and notebooks into the jeep wagon and drove back to a crescent-shaped outcrop surrounding a sandy-bottomed pool. At this, our first collecting site at Dourada, many of the species of shrubs and herbaceous plants we found seemed very similar to those we had collected a few weeks earlier under similar circumstances at Chapada dos Veadeiros, a crystalline range several hundred miles to the east of Serra Dourada. Like Veadeiros, the summit of Dourada consisted mainly of rock-strewn campos interspersed with thicket-grown outcrops and wooded creek borders.

We looked for and collected samples of any species of plant that was in identifiable condition, trying to get enough of each kind to make up 10 duplicates. Each duplicate consisted of a single plant, or several little ones, or flowering or fruiting branchlets of larger ones such as shrubs and trees. The idea was to find enough good specimen material to spread over one half of a single newspaper sheet. The other half of the sheet was folded over the specimens, making a folder. The specimen filled newspaper folders were then piled up, one upon another, and kept tied between two lattice frames. Each folder was numbered and notes were entered against corresponding numbers in a pocket-sized field book. When the day became windy and sunny, it was necesary to put the specimens in newspapers almost immediately after they were collected or they would become so limp as to be difficult to arrange. The newspapers we used for specimen folders were remainders purchased in 100-kilo lots from the Correio Brazilienze (Brasília Mail), Brasília's only newspaper, supplemented by a worldwide variety of newspapers given to us from time to time by the university library. These donated sheets proved more trouble than they were worth in cash savings — they were of many different sizes and most had to be trimmed to fit our plant presses. Still, any local supply was a great economy over our earlier practice of shipping a ton of tabloids from New York.

With the exception of Sidney's legume seed collections (discussed later) and a few seedlings I potted up and took back to the university's new botanical garden, we made no attempt to collect living plants. Our first order of business was to get specimen material on which to base a botanical inventory. In the future we may pay closer attention to promising horticultural subjects but, as in most places, only a small fraction of the native flora of the Planalto is both ornamental and suitable for cultivation.

From the outcrop we walked down a steep slope to the top of an escarpment which we skirted and then, descending a couple of hundred feet, approached from the base. There on the moist, shaded cliff face and its wooded talus slide, we found more

curious plants. Raimundinho quickly bounded up a tree and from a high limb plucked aroids and bromeliads growing in crevices from which water dripped on us below. Raimundo gathered samples of the different kinds of grasses and sedges in the area. Two years before, Raimundo had worked as field assistant to Dr. Thomas R. Soderstrom, grass specialist of the Smithsonian Institution, who was with us during the first field operation of the Planalto Program. Tom showed Raimundo the special techniques of grass-specimen preparation. During that 4-month training period, Raimundo caught some of Tom's enthusiasm for the plants themselves. Since then he has taken over the collection and preparation of that very important part of the Planalto flora.

Raimundinho shifted his collecting from the cliff face to the trees that supported him. Scanning the treetops, scrambling up, down, and across, he found an *Aristolochia*, rather like our Dutchman's-pipe vine, a couple of epiphytic orchids, and a very conspicuous orange-flowered mistletoe.

As specimens came to me for notation, I numbered the appropriate sets of folded newspapers in which they would be pressed, and then noted in my field book the features of the living plant that would not appear in the dried specimen: plant habit, flower and fruit color, odors, textures; also date, locality, habitat features, and height and trunk-diameter of trees.

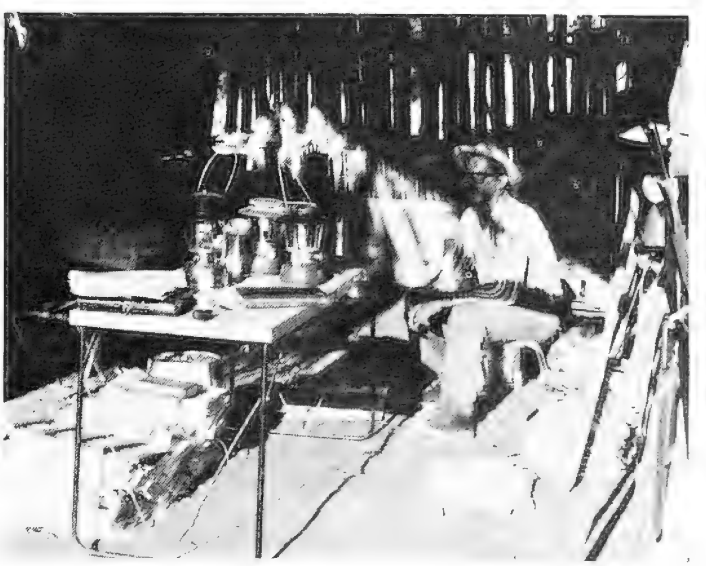
Sidney, who worked not only for the Planalto Program but also as a part-time seed collector in the Alliance for Progress' Pasture Research Project, roamed the fields in search of legume seeds. The legume family, with its well-known soil enriching capacity, is an important plant group on the Brazilian cattle ranges. Soils in the Planalto's thousands of square miles of fields are generally very poor, compacted clays of low nutrient value. Such soils support few of the superior range grasses, with the result that the cattle population must be spread very thinly over a vast area. The legume seeds that Sidney hunted and collected were from well-adapted native species whose soil improving capacity was unknown. After each of our trips (14 besides this one to Serra Dourada) Sidney sent his packets to the Project's experimental farm in São Paulo state. There the plants are grown; checked for soil improving capacity, palatability to stock, drought resistance, and soil tolerances; and then rated for use in various parts of Brazil. It is hoped to find or develop leguminous plants suitable for ranges all over the country.

Back at camp, we each drank a cup of lemonade and felt relieved to take shelter from the brilliant January sun. Dorothy had arranged our aluminum table for lunch and Elizabeth, during her morning's search for interesting rocks, had found a branch which, when pruned and thrust in the ground, furnished just the right number of stubs for our GI cups. Soon we had lunch: rice topped with beans and corned beef, followed by goiabada (a delicious fruit paste made of guava and sugar) and cafezinho, a demitasse of sweetened black Brazilian coffee.

Afternoon

After lunch we collectors retreated to the work area. Each took a hand press full of the morning's collections and sat down in the cool shaded grass next to an empty drying press, ready to put in about two hours of specimen preparation. By this time the specimens in the hand press were limp. Each newspaper folder was opened and the specimens were arranged to impart as natural an appearance as possible, without too much overlapping of parts; creased leaves were spread open, flowers were left exposed, and excess stem was trimmed off. Thick fleshy parts were slit to permit rapid drying. The prepared specimen in its newspaper folder was then put into the drying press, which consisted of a stack of blotter-faced sheets of corrugated aluminum alternated with the specimen folders. By the time my hand press was empty, the drying press had risen to five feet and leaned against a pole. Raimundinho, who had finished first, filled the tanks of the kerosene pressure stoves. The rest of us passed two heavy webbing straps around each press, groaning as we cinched up on the buckles. Raimundinho set up the boxlike press frames. Each frame, about 4 feet long, 18 inches wide, and 2 feet high, had an open top over which we placed one of the 100-pound drying presses. A lighted stove was passed inside the frame through a small side door. The stove, pumped up hard, was good for a couple of hours before pumping was needed again. Nearly everything would be dry in eight hours.

In late afternoon, collector Raimundo finishes putting up grasses and prepares to become cook. First-aid kit, trowel, and field book share table with pressure lamps that will illuminate area for night press change. This camp was made in an abandoned road-crew shelter.



It was nearly 3 p.m. and the western skies were heavy with ominous nimbus clouds. I decided to set off on foot to collect in the gallery woods about a half mile distant from camp. Raimundinho came along, ready to be "monkey," or macaco, as he is playfully called for his climbing skill. Sidney was third, carrying his shoulder-slung pack of seed envelopes and scanning the fields for dry, rattly pods. Raimundo stayed behind to keep an eye on the pressure stoves and to collect grasses around the camp. Later he would help Marian get supper underway. She and the girls went off to take pictures, but decided on a dip in the creek before the sky got any darker.

At the edge of the gallery I spotted a jacaranda with drooping wine-purple flowers. Raimundinho saw it too, and was instantly twenty feet above the ground, in the branches of a more easily climbed tree next to the jacaranda. Just as suddenly, he dropped to the ground, frantically swiping at his shirt, which he tore off and flailed about him. The air hummed with maribuntas – little black wasps. It was all over in a moment. The wasps dispersed and Raimundinho smiled faintly, despite the score of little red welts that rose on his forehead and neck. "They were hidden up there," he said, pointing upward to a tree crotch. "I stepped on their nest." We got our jacaranda specimens elsewhere.

Evening

After another hour or so, the skies darkened perceptibly, the thick leathery leaves of a nearby wild fig clattered, and we knew that rain would soon be on us. We bundled up our field presses and started back to camp. As we reached a hilltop, we saw the wall of gray to the west. Minutes later, with the camp in sight, we heard the roar of the approaching downpour. We bolted at top speed, abandoning the winding cattle track and heading straight for camp. But in seconds the deluge caught us and in a few more seconds we were drenched. Marian and Raimundo laughed as we ran panting under the big tarp, our clothes clinging but our specimens intact.

Raimundo had already pulled the drying presses in from the wind-driven rain, so we changed into dry clothes, and I set about completing my notes for the afternoon's take while Raimundinho prepared the wick stoves that would be used for drying specimens during the night. A wick stove resembles a flat cookie tin with a circle of ten wicks rising through the cover into a ventilated cone. A hot blue flame rises from the cone and burns without attention for about eight hours. The heat from one of these stoves is less intense than that given off by a pressure model, but usually the nights are still enough so that less heat will accomplish the same drying.

When the rain let up, Sidney checked over the jeep wagon. He tracked down and tightened the

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Brasília

The Planned City

In 1959 when I was in Brasília – a planned city begun by President Kubitschek in 1956 to become the capital of Brazil – it consisted of some paved roads leading nowhere, two soldierly files of undressed steel frameworks, and a scattering of slab-sided boxlike buildings of other worldly design. Nearby was Nucleio Bandeirante (Pioneer Center), its long dusty street lined with hastily built shacks; the most presentable of them housed banks, hotels, bars, restaurants, shops, and a movie theater in a gigantic Quonset. These were facilities for the "pioneers," most of whom were immigrants from Brazil's parched and impoverished Northeast. Here, for the first time, these hardy souls had electricity, running water, and steady jobs. It was an exciting place, spirited and lively, and except for the jeeps and diesel trucks, like towns in our own early West.

Brasília is no longer "Kubitschek's folly" but a busy, thriving city. Although it is one of the most closely planned of planned cities, its establishment and now unquestioned permanence have brought on political, social, and economic consequences that President Kubitschek, architect Oscar Niemeyer, and city planner Lúcio Costa did not anticipate. For example, Brasília's basic plan – the governmental and commercial center (likened to a bird in flight) surrounded by a half-dozen residential communities 10 to 20 miles distant – requires a dependable, efficient system of public transportation, but commutation now costs up to 15 per cent of a worker's salary. With distances so great, even within the city limits, the

At home in Brasília, the Irwins are ready for an evening out at a restaurant. Marian taught at the American School in Brasília, where Elizabeth was the only eighth grader and Dorothy one of six in fifth grade.

convenience and versatility of the automobile have made it increasingly popular. The ratio of cars to people is higher in Brasília than in any other Brazilian municipality. Traffic jams and parking problems already beset the rush-hour commuters in this city that is not yet a decade old.

Originally, city planner Costa hoped that chauffeurs and ministers would make their new homes in the same buildings, forming an unstratified society. In those early days, all of Brasília's sparkling new apartment buildings, government constructed and controlled, were available for practically no rent. But now, in order to set up a revolving fund for new construction, apartments are being sold, rather in the manner of our cooperatives, at prices no chauffeur can afford. Costa had hoped to prevent the shanty slums that surround most Latin American cities, but they have sprung up as immigrants continue to pour in from the Northeast at the same time that Brazil's inflationary economic spiral leaves low-income laborers destitute.

As Raimundo drove us downtown to our hotel, I was reminded that Brasília is a city of remarkable class homogeneity and, in keeping with its own tender age, a city of young people. Everyone agreed, regardless of his walk of life, that much more is accomplished day by day in Brasília than in Rio de Janeiro, the former capital of Brazil. The climate is more conducive to work; nights are cool, air is clean, streets are relatively quiet. The city is spacious and uncrowded. It is a family town, but with a difference. Each family is alone and on its own, without the several generations of relatives with intertwined lives and interdependence. Social life, such as it is, centers on the immediate family. We heard on the one hand, "I have more friends here than I ever had in my life"; on the other, "There is little to do but have parties." Restaurants, night clubs, concerts, exhibitions – all are few and infrequent. Entertaining is done at home.

Another of Brasília's departures from the Brazilian norm is the great number of working wives. In much of the country women still do not leave their homes to work in offices, but in Brasília, with its plentiful supply of servants and handy neighborhood schools, about two-thirds of the married women work as secretaries in government offices.

The University of Brasília

The university, another of Brasília's unique features, was the conception of former president João Goulart. At its official opening in 1962 the institution was hailed as a departure from the European model that had always guided higher education in Brazil. Instead of the usual rigidly separated, semi-autonomous faculties, there were American-style departments staffed by a more fluid, public-spirited professorial hierarchy; the intention was to allow students a much broader choice of subjects. The 1000 students, drawn from all over Brazil, developed a true college spirit.

As in most Latin American higher institutions, the University of Brasília harbored, according to the Brazilian press, a number of political leftists, perhaps even communists. With the fall of President Goulart in 1964, the new revolutionary government of President Castelo Branco zeroed in on the university as a seat of opposition. At the time of our arrival in 1965, several professors and department heads were dismissed and the university's administrative head, the rector, was replaced. Nearly all the faculty resigned. Students demonstrated. Police set up roadblocks. Within two months the four teeming university-owned apartment buildings, in one of which we were given a furnished apartment, were all but empty. The university was deserted. If we had not been busy, we would have found the University of Brasília a most depressing place to live. Slowly the less controversial of the university's departments returned to activity by the end of our year. At no time during this troubled year in the university's history was our work interfered with. In fact, with only one or two exceptions, we were able to remain completely detached from the disturbances.

Our Year in Brasília

About half my time in central Brazil was spent in the vicinity of Brasília. The two Raimundos and I, joined by John Grear when he arrived at the end of January 1966, made repeated visits to selected localities in the Federal District to supplement our earlier collections from those places. In this way we built up a very thorough collection of specimens of the plants of the District. This collection, a set of which is deposited in the herbarium of the University of Brasília, will form the basis of the first published flora of the Federal District.

Besides collecting locally, we spent the time between long excursions having the vehicles serviced; unpacking, sorting, and repacking the specimens from the previous trip, in a large room provided by the University; and, in the evenings at least, relaxing in our spacious apartment. Most of our excursions lasted from one to three weeks; the final and longest one – from mid-May to early July – took us to northeastern Mato Grosso.

Before we left New York, Marian had been appointed a teacher in the 2-year-old, 40-pupil American School in Brasília. Although she had no teacher training, her English literature college major and subsequent experience in Scouting and religious education won her a contract to join the other three teachers at the school. The essentially American elementary school curriculum was supplemented by an hour's instruction in Portuguese for all pupils. In the first semester, classes were held in a few rooms in a large parochial school; later the school was moved to a vacant suite in an apartment building. Marian's subjects were English and social studies for fifth, sixth, and seventh grades. Her classes were mixed in nearly all respects – simultaneously she had boys and girls, Brazilians and Americans, and fifth, sixth, and seventh graders. The school's academic year, arranged to conform more or less with that of Brazilian schools, had begun a few weeks before our arrival in August and it ended in June. The school observed frequent holidays – some Brazilian, some American – and two 6-week vacations. The December-February vacation (Christmas and summer vacation combined) gave Marian and the girls a chance to come along to Dourada. However, during most of my time away from Brasília, I and they were content with their involvement in an undertaking almost as unique as my own. Marian's after-dinner occupation – planning lessons, grading papers, and worrying over this or that student – took me back to my teaching days at Queen's College in British Guiana. Occasionally we would chuckle about teachers' strikes in New York, in light of Marian's $60 pay check at the end of the month.

After our years of American suburban living, we found the furnished apartment on campus a bit confining. But life there was never dull; power failures in the rainy reason averaged two or three each week, and for a month-long period when the water pressure failed we spent hours trudging up the six flights of stairs with full buckets. We hired a carpenter to make window screens and borrowed a refrigerator, but otherwise made do with such spartan appurtenances as bare-bulb lamps and overturned boxes for occasional tables. As daughter Dorothy said, it was almost like camping indoors. She, Elizabeth, and Marian made a weekly after-school shopping excursion to at least two supermarkets, one of them part of a government sponsored co-op chain, the other private. Food selection depended on the season and the frequency of truck arrivals from the industrial South. Fresh produce was very inexpensive, canned things cost about the same as they do in New York, and manufactured goods were generally considerably higher in price.

Although man-made recreational facilities in Brasília were few, we had fun on Sundays walking, picnicking, driving to nearby towns, and, during bad weather, reading or chatting with some of the many Peace Corps volunteers who work in the Federal District. Raimundo and Raimundinho lived in a small house I rented for them nearby; they continued to work seven days a week. We had decided in advance that our year in the Planalto of Brazil would be a year of work; in retrospect we can say that for all of us it was enjoyable and unforgettable.

HOWARD S. IRWIN

At supper, from left: José Ramos, Raimundo Reis dos Santos, Raimundo Souza, Sidney Fonseca, Francisco Rocha, and Dr. Irwin eat rice, beans, and corned beef while listening to a news broadcast. Extreme right, back to camera, is Antonio Rocha. José, Francisco, and Antonio were hired to help Royal Society group on the Mato Grosso trip.

offending bolt that had produced a loud rattle under the hood. He drew enough gasoline from a 55-gallon drum in the bus to fill the jeep tank and checked motor oil, radiator, battery, and tires with a quick, appraising eye. I had come to know that if Sidney finished one of his daily servicing checks without comment, our vehicles would be ready to go the next morning.

We had a delicious dinner by lantern light – rice, beans, corned beef, macaroni and cheese, fresh bread, and cafezinho – then went back to our presses. Down came the four drying presses that we had put on the frames six hours earlier. We released the straps and examined the still hot specimens, pulled out the newspaper folders of dried plants, and put in the wet, newly collected material. Again, the process took just about two hours; then the strapped drying presses were lifted onto the frames. Wick stoves replaced the empty pressure stoves. Bundles of dried specimens which had been taken out of the hot presses were tied between corrugated cardboards and packed in cardboard boxes with naphthalene flakes. We stacked the packed and taped boxes in the bus and drew newspapers from our bale for the next day. The kitchen was cleaned up and a pot full of beans left to soak. It was ten o'clock and by tacit agreement time to quit.

The Hazards and the Joys

This account of a fairly typical field day omits many interesting occasional occurrences, such as the time the old wooden road bridge in Mato Grosso gave way under the jeep and cost us two days of unloading, jacking, and replanking; or the time the bus sank into the cavernous underground ant nest hidden beneath a newly scraped dirt road; or the appearance of a Brazilian rattler, appropriately named *Crotalus terrificus*, in the warm kitchen one cold July evening; or the night in Goiás when an enormous tapir lumbered into camp, upset the kitchen and, in its alarmed haste to escape, levelled a tent. Nor does it include some of the unique joys we experienced: the wild life-saving ride we gave to a fever-wracked baby, whose desperate mother we found exhausted on the road, not knowing how she would get to the nearest clinic 25 miles away; the warm camaraderie with an old white-thatched fazendeiro (rancher) at whose place we always stop and camp when passing through; the sheer joy and excitement felt by a naturalist at being in a place, as in the fields and forests in Mato Grosso adjacent to a roadhead, never before trod except by native Indians.

Above: Makeshift bridge splintered under laden jeep and all hands pitched in to prevent car from slipping into creek. Jeep was unloaded and jacked, and new logs were cut to replace the broken bridge. Bridges caused more travel delays than any other road factor.

Below: Dr. Irwin picks away at rocks hanging up the bumper of the bus on an unpaved state highway. Later, the bus body was altered and the bumper raised to increase clearance over rough roads. Inside bus are camping gear and cases of dried specimens.

Post-expedition Work

Back here at The New York Botanical Garden, the post-expedition work continues at undiminished pace. Labels have been typed and duplicated for all plant collections. We have sent selected specimens worldwide to more than 50 taxonomists who are specialists in various plant groups; as of spring 1967 we have received about 2500 identifications. As identification lists come in, the plant names are typed on the appropriate label forms, which are tucked in with the specimens. Then we send duplicate specimens to other herbaria in exchange for their surplus duplicates. The herbarium of The New York Botanical Garden will be richer not only by the 11,000 different specimens collected on the Planalto Project in 1965–1966, but by more than 50,000 other specimens that will be acquired by exchanging duplicates. Most important, taxonomists the world over will at last have specimens from this remote area at their disposal.

The Quest for Knowledge

The motivation for botanical surveys is the quest for knowledge. Plant research, in all its diverse turns, is based upon a knowledge of the kinds of plants that exist. Taxonomists are frustrated in their attempts to get this information by their own small numbers, by the increasingly rapid destruction of natural habitats as a consequence of human occupation, and by the persistent inaccessibility of vast areas of the earth's surface. The identification of specimens is done in great part by specialists in the taxonomy of certain families or genera; these specialists work in educational and research institutions all over the world – taxonomy is one of the most international of activities.

Taxonomists everywhere know that the world's greatest untouched botanical treasures lie in the interior of South America – the "lost world" of the Guayana Highlands, the endless forests of the upper Amazon, the craggy slopes and plunging valleys of the Andes, and the fields, scrublands, and wooded stream banks of the Planalto of central Brazil. Since its founding, The New York Botanical Garden has sent explorers to many parts of this treasure land. Such names as Rusby, Britton, Krukoff, and Maguire come up every day in our conversations about plant exploration and in our work on the plants that have been brought back for study and identification. The roster of names changes little by little, but the Botanical Garden's preeminent role in this work continues.

The need for exploratory work in central Brazil is graphically proved in the dot maps used by taxonomists to plot the geographic distribution of plant species. The source locality of each specimen, as indicated by its label, appears as a dot on a blank outline map. Maps for species of interior Brazil seem always to have a broad east-west blank area from about 5° to 15° south latitude. Much of this blank zone is in the Planalto of Brazil; the rest lies in Amazonia. Until recently, difficulty of access has kept this region beyond the reach of plant explorers.

Shaded area is the region in the Planalto of Brazil that in nearly all dot maps remains blank for lack of exploration. Dots represent actual collection sites of various varieties of *Cassia tetraphylla*, a tropical American legume. (Author's map; reprinted from *Memoirs of The New York Botanical Garden*, Vol. 12, No. 1, August 1964, page 91.)

The Planalto of Brazil differs from most other interior regions of South America in that it has become accessible and is now fairly easily traveled. The last decade has seen not only the construction of the city of Brasília, but also the laying down of a highway net to such distant points as Rio, São Paulo, Cuiabá, and Belém. Suddenly, the botanist's main problems – access to and transport in the field – have been solved. Indeed, the solution has come so quickly that the botanical community has only recently become aware of it. The rapid influx and settlement of Brazil's burgeoning population along these new routes, coupled with the still prevalent conquest-of-nature philosophy held by nearly all civilized peoples, has led already to the destruction of great tracts of woodland – not so much for the wood as for access to the tillable soil beneath – and, by repeated burning of the campos, dry season after dry season, to the marked deterioration of their natural cover.

Botanical Exploration Requires International Cooperation

The stereotype of the tropical explorer persists as a pith helmeted, machete swinging, grim faced individual forging ahead through the jungle despite hazard and pestilence, leading his doughty band

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2

STEPS IN MAKING

Herbarium Specimens

1. In the field, the leaves and curious maple-like fruits of *Centrolobium tomentosum* are cut and arranged for pressing on a numbered half sheet of newspaper.

2. Back at camp, Dr. Thomas Soderstrom examines and rearranges specimens in their newspaper folders as he builds a press.

3. Dr. Ghillean Prance places a kerosene pressure stove inside a collapsible press frame.

4. Filled presses, each with perhaps 100 specimens alternating with corrugated aluminum and blotting paper drying units, all bound and compressed by two heavy straps, are placed over heat for about 8 hours. Bulky fruit, bark, and root specimens are dried separately.

5. The dried specimens, still in their newspaper folders, are sealed with napthalene flakes in heavy cardboard boxes and stored in the bus until the return to Brasilia.

Dr. Soderstrom, Curator of Grasses at the Smithsonian Institution, and Dr. Prance, Associate Curator and leader of the New York Botanical Garden's Amazon exploration program, joined Dr. Irwin in the Planalto in 1964.

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The field party grew to eleven when joined by Royal Society people for the Mato Grosso trip. Besides the Botanical Garden's graduate student John Grear (third from right, rear), principals included David Hunt of Kew (rear left, white hat), Dr. Iain Bishop of Leicester University (rear right, hatless), and Alistair McKenzie of the Royal Society (with pipe).

of bearers to a scientific El Dorado, but the fact is that little field work is done in this manner today. Exploration has become a team effort that requires international cooperation in planning, in the actual field work, and in the study that follows. Increasingly, whole programs are framed as joint efforts involving many institutions. Already The New York Botanical Garden's Planalto Program has had the field collaboration of the University of Brasília, the Instituto Agronômico do Norte (in Belém), and the Smithsonian Institution; the Missouri Botanical Garden may participate in the near future. The Royal Society and the Royal Geographical Society will soon set up a joint biological research station on the Xingu River in extreme northeastern Mato Grosso. Plans are being developed for collaboration between The New York Botanical Garden's Amazonian and Planalto programs and the Royal Societies' project. As construction carries the Brasília-Manaus road northwestward, access into this vast area will at last be possible.

To the north and south of this unexplored region, that is, in the navigable portions of the Amazon drainage as well as in the long-settled but thinly populated southern part of the Planalto, the earliest exploration was done a century and a half ago. Interestingly enough, in this time of great advances in transportation, the Amazon River launch is still – for the Botanical Garden's Ghillean T. Prance today as for Richard Spruce in the early 1800's – the most satisfactory method of getting about in northern Brazil. In the Planalto the historical field excursions of Sello, von Martius, and Gardner were by horseback and, in places, by wagon. Today's horse is the jeep, its utility minimizing ignorance, disease, and isolation.

Far left: The basic field party — Francisco Rocha (later replaced by Sidney Fonseca), driver-mechanic; Dr. Howard S. Irwin; tree climber and collector Raimundo ("Raimundinho") Souza; and cook and collector Raimundo Reis dos Santos.

Left: Picnicking and roaming the fields in the hot February sun is weekend fun for Dorothy and Elizabeth Irwin. Behind them lies Lagoa Paranoá, Brasília's enormous artificial lake, and the outskirts of the city.

Is There Any Wonder . . . ?

With more than 300,000 persons living in the new Federal District of Brasília, with a 3.5 per cent national annual rate of population increase, with the products of the industrial South transported for distribution to an awakening North, the pristine, unexplored area of Brazil diminishes every year. Five years ago bulldozers pushed a 1200-mile road from Brasília to Belém, the commercial center of Amazonia. Another, to the Atlantic port of Fortaleza, has been completed. And now, as has been mentioned, a third road is being cut from rocky ridges and forested valleys, headed northwestward for Manaus. Little shack clusters on the newly opened Belém-Brasília highway – like the restaurant-fuel stop called Presidente Kennedy, founded in memory of the late president early in 1964 with perhaps 50 hardy souls – today boast 25,000. For more than a century Brazilians have talked of moving inland to occupy the remote hinterland. With Brasília's existence to serve as a catalyst, that movement is underway.

Naturalists must try to follow the freshly bulldozed tracks but keep one jump ahead of the colonists. In a land so vital and vast, it is an impossible task. To prepare an inventory of living things in the Planalto will require the collaborative efforts of an international force of naturalists. Is there any wonder that we all sense a note of urgency, that efficiency in our day-to-day field operations looms increasingly important, that still broader collaboration at all levels must come?

One of our most pressing obligations is to encourage the participation of students – Brazilian, American, and others – some of whom may be stimulated to continue with this work. Their participation as trained assistants is valuable to the operation of expeditions; for students there is no better way to become acquainted with the plants and to savor the excitement of the undertaking.

All of us were silent on our last trip out to Brasília Airport on August 10, 1966. I felt we had accomplished a great deal – far more than we would have in four separate 3-month expeditions. Yet, I had the gnawing feeling that we had hardly begun. Symbolic of a rapidly changing Brazil were the fields of little shacks – most with radio aerials, a few with TV antennas, homes to someone – where only two years earlier Raimundo, Raimundinho, and I had walked unimpeded and collected *Cassia linearis* and *Cassia brachyblepharis*, two little-known legumes found only in the environs of Brasília. It was appropriate that, as we disembarked from the jeep wagon at the airport terminal, we bade our faithful assistants "Ate logo" and not "Adeus"; we will return for the third field period of the Planalto Program in January 1968. ■

Basic and Applied Research

By William C. Steere

ON CLOSE examination, the differences between basic or "pure" research and applied research or technology turn out to be almost impossible to identify and formulate. At one end of the spectrum of research we find scientists working on problems so abstruse that they are sometimes considered ridiculous by the uninformed public; such scientists too often become the butt of cartoonists and writers of television scripts. Even though basic research may not have immediately useful applications, it does swell the total body of knowledge so essential for successful technology. At the other end of the research spectrum, we find engineers and technologists who have the responsibility for investigating problems of great and immediate importance to industry, medicine, and the defense effort—and for solving them. In short, whereas some scientists work under no pressure from either personal motivation or institutional requirements to produce results of immediate utility to man, other scientists possess a strong individual drive, perhaps enhanced by the demands of their positions, to come up with results so obviously useful that they deserve to be patented.

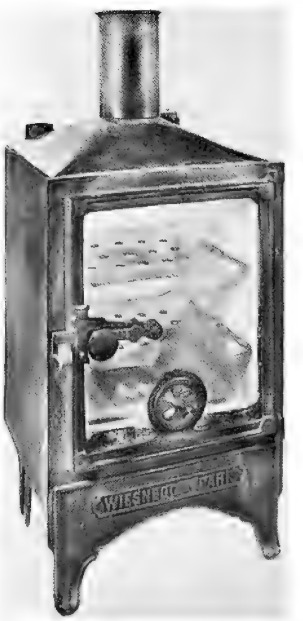
Although the ends of the spectrum of scientific research may appear to show sharp contrasts, these apparent differences disappear in the extensive middle ground, where chance may play a very large role in determining whether or not new ideas may be applied. Many great scientific discoveries, of enormous practical value today in medicine and industry, have turned up more or less by accident, and not necessarily as the direct and planned result of an experiment. Serendipity, that gift for finding valuable things not sought for, is a talent to be prized highly by scientists!

Puffed Cereals — Immediately Useful

As an outstanding case of immediate applicability of the unanticipated results of basic research, I can cite the discovery of puffed wheat and puffed rice at The New York Botanical Garden in December, 1901, by Dr. Alexander P. Anderson. Earlier in that year, Dr. Anderson had resigned the Chair of Biology at Clemson College to accept the position of Curator of the Herbarium of Columbia University. He had received the degree of M.S. from the University of Minnesota in 1895 for his researches on the growth of plants with Dr. MacDougal, and the Ph.D. from the University of Munich in 1896 for investigations in plant diseases with Professors Goebel and von Tubeuf.

In a still-interesting paper, "A new method of treating cereal grains and starchy products" (Journal of The New York Botanical Garden, volume 3, pages 87-89, 1902), Dr. Anderson says "... in the Laboratories of The New York Botanical Garden every facility was given me for the prosecution of the work. I am indebted to the ... institution for the use of a chemical laboratory which was placed at my disposal and for a plentiful supply of material of all kinds as well as for encouragement and helpful suggestions from the members of the staff." Dr. Anderson's basic research dealt with the formation and structure of starch grains as well as the effect of combined heat and pressure on them. As part of his investigation, he heated air-dry grains of several cereals in sealed glass tubes in a special oven to a temperature of 400 F, at which the residual moisture in the cereal grains built up a pressure of 200 pounds per square inch. When these heated tubes were taken from the oven and imme-

Alexander P. Anderson
1862-1943



Puffed cereals were first produced in this small oven at The New York Botanical Garden in December 1901 by Dr. Alexander P. Anderson. The oven, 21 inches high, 10 inches wide, and 10 inches deep, is displayed in the Museum Building at the Botanical Garden.

DR. STEERE is the Director of The New York Botanical Garden.

diately cracked open with a hammer (using suitable precautions!), the sudden release of pressure caused the grains to explode to many times their original size, although they retained their original shape.

Dr. Anderson was not oblivious to the economic value of his discovery, which caused a great furor in the popular press. In the paper just quoted he says, "The process is applicable to nearly all starchy seeds and starchy substances, greatly increasing their nutritive availability. The products obtained are pleasant to the taste, and the process may be varied to produce a great variety of flavors with any given cereal. Furthermore the material prepared in this manner is absolutely sterilized and may be preserved or stored for long periods. I am led to hope from the approval the products have met from food and chemical experts that the process may prove of great economic and commercial value." Dr. Anderson resigned from Columbia University at the end of his eventful year and became an expert consultant to the syndicate that developed machinery and techniques to translate his laboratory discovery into commercial production; the U. S. Patent Office granted him letters patent No. 707892, dated August 26, 1902, upon the "Art of Treating Starch Material." In gratitude to the Botanical Garden, he established and endowed the Alexander P. Anderson and Lydia Anderson Research and Fellowship Fund, whose income is still available for fellowships and for research.

Research on Effects of Ionizing Radiation on Plants Not Applied for 40 Years

On the other hand, some research may produce results so far in advance of the current state of knowledge and technology that we find ourselves unable to exploit them, and decades or even generations may elapse before they can be applied to some useful purpose. For example, the basic theoretical concept underlying nuclear fission was elucidated by the turn of this century, more than 40 years before the Manhattan District with its investment of untold millions of dollars was able to develop the equipment, techniques, and materials essential to bring about the first man-made atomic explosion. Likewise, the pioneer program of fundamental research begun at The New York Botanical Garden in 1904 by Dr. C. Stuart Gager, and the major publication that resulted from it, *Effects of the Rays of Radium on Plants* (Memoirs of The New York Botanical Garden, volume 4, pages 1-278, 14 plates, 1908), were so far ahead of their times that they did not receive the general recognition and understanding from contemporary scientists they deserved.

Dr. Gager, who held the title of Director of the Laboratories at The New York Botanical Garden (and who, in 1910, became the first director of the Brooklyn Botanic Garden), began his work when the science of genetics was just an infant, and the then recently rediscovered laws of heredity put forth by Gregor Mendel in 1866 were still being tested. Consequently, it was not possible for Dr. Gager to foresee the role that his results and techniques would play, many years later, in research devoted to the effects of ionizing radiation on heredity in plants and animals – including humans. Although he produced some mutations by the irradiation of seeds with X-rays, he concluded "that most of the variants were not true mutations, and that further evidence is needed before we may say with entire confidence that mutation may be induced by the stimulus of radium rays."

C. Stuart Gager, 1872-1943

The establishment of the Atomic Energy Commission in 1946 brought about substantial support and encouragement of research on a wide range of atomic problems, and the many effects of ionizing radiation on plants became a research subject of major importance. Finally, after more than 40 years of relative neglect, the full significance of Gager's experiments have been appreciated.

Research is the basis of our age of science and technology, whether or not its results are of immediate utility to man. Many investigations may seem "long-haired" or almost ridiculously abstruse, but we may be sure that their results will enlarge and enrich our total body of knowledge – and, by some happy accident or serendipity, they might even turn out to have important and immediate application. It is clear, then, that the support of botanical research and of imaginative and creative investigators is urgently necessary in today's world. ■

MORE ON

Latin Names of Plants

By Harold William Rickett

Recently I wrote a piece (this Journal, January-February 1967, page 38) about the botanical or Latin names of plants. I pointed out the simplicity of botanical nomenclature, and showed that many who are afraid of it are actually using it for the names of genera.

Genera (plural of genus) are the "kinds" of plants in a broad sense: all the roses are a genus, all the lilies another; each is named by a single word, as *Rosa, Lilium.* Many of these names are in common use by gardeners and nurserymen; they need no further exposition here.

Within a genus we find species; their names are made of the genus-name (called the generic name) plus a second word: *Rosa gallica, Lilium tigrinum, Viola pedata.* Such names may indeed – in the current neglect by the schools of the Latin background of our language – dismay the intellectually timid or slothful. Yet the second word – known as a specific epithet – has meaning, often evident to anyone who will really look at it. Most specific epithets are Latin adjectives, or Latinized Greek adjectives, often descriptive of some characteristic by which one distinguishes the species. Others commemorate some collector or botanist.

A complete dictionary of these words cannot be given here. (Aside from the Latin dictionaries, William T. Stearn of the British Museum has lately given us a volume entitled *Botanical Latin* [Hafner Publishing Company, New York, 1966, $16.75] in which an extensive vocabulary is provided.) But it is possible to list and explain even in this brief compass a number of epithets that occur over and over again, attached to different generic names. To become familiar with these is to take the first large step in the knowledge and appreciation of the international lanugage of botany. It is not difficult.

The Endings of Latin Words

First a note on the endings of Latin words. They change with number and gender – niceties that the English language lost long ago. (We still, however, distinguish the masculine "actor" from the feminine "actress," and the nominative "I" from the accusative "me.") A Latin adjective changes its gender to fit that of the generic name to which it is attached. Most adjectives that concern us here end in *-us* or *-er* (masculine), *-a* (feminine), *-um* (neuter); or in *-is* for masculine and feminine and *-e* for neuter; a few ending in *-or* or *-ns* do not change endings with gender. So we write *Helianthus annuus* and *Helianthus occidentalis, Viola palmata* and *Viola canadensis, Lilium philadelphicum* and *Lilium canadense.* The form of the generic name usually gives us the gender; even when this is not true (e.g., *Quercus alba),* the reference books supply the example to be followed. In what follows, all adjectives are listed in the masculine.

Epithets Made from Names of Persons

Many epithets are made from the names of persons – the first collector of a species or someone in some way responsible for its classification. The person is transformed into a citizen of ancient Rome by the addition to his name of *-ius* or *-us,* or *-ia* if it is a lady: Torreyus, Nuttallius, even Rickettius. The noun thus made appears generally in the genitive (possessive) case: *Lobelia nuttallii* (Nuttall's lobelia), *Triphora rickettii* (Rickett's triphora), *Eupatorium luciaebrauniae* (Lucy Braun's eupatorium). Or the name may acquire an adjectival ending: *Viola brittoniana* (literally the Brittonian violet, i.e. named for N. L. Britton).

Compound-word Epithets

Many specific epithets are compound words which join a descriptive adjective or a numerical prefix to the name of some part of a plant. So we have *brevicaulis,* from *brevi-* (short), and *caulis* (stem): "short-stemmed." *Brevisepalus* means "with short sepals"; and *flexicaulis,* "with bent stem." Learning the meanings of some of the comparatively few

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words that make such compounds unlocks the significance of hundreds of botanical epithets. Here they are:

Descriptive Adjectives

albi- and Greek *leuco-*, white.
angusti-, narrow.
brevi-, short.
flexi-, bent or flexuous.
grandi-, large.
lati-, broad.
longi-, long.
macro-, large or long.
multi-, many.
parvi-, small.
pauci-, few.
rotundi-, round.
sessili-, sitting, i.e. without a stalk.
tenui-, slender.

Numerical Prefixes

uni- and Greek *mono-*, one.
bi- and Greek *di-*, two.
tri-, three.
quadri- and Greek *tetra-*, four.
quinque- and Greek *penta-*, five.
a- (Greek particle), without.

Parts of a Plant

caulis, stem.
carpus (Greek *karpos*), fruit.
flos, (-florus) and Greek *anthos*, flower(s).
folium and Greek *phyllon*, leaf.
pes, foot, i.e. stalk.
petalum, petal.
sepalum, sepal

With the above tenuous linguistic equipment such epithets as *longifolius, quinquefolius, microcarpus, acaulis, sessiliflorus, pauciflorus, latifolius, longipes, leucanthus* should have no terrors.

Geographical Epithets

A second group of epithets are obviously geographical, referring either to the region where a species is abundant or (more commonly) to the place where it was first discovered. *Lilium philadelphicum* is not confined to Philadelphia, but was first observed near there. *Iris missouriensis*, common in the western United States, was discovered near the headwaters of the Missouri River. *Astragalus arizonicus* is abundant in Arizona.

Many of these words are simply state or country names that have been given Latin endings; they require no translation: *americanus, arizonicus, arkansanus, californicus, canadensis, carolinianus (caroliniensis), floridanus, illinoensis, marilandicus, mexicanus, missouriensis, ohioensis (ohiensis), pensylvanicus, philadelphicus, texanus (texensis), virginianus (virginicus, virginiensis)*. Similar words, of course, describe states or countries or areas in the Old World: *anglicus, chinensis (sinensis), indicus, sibiricus, suecicus.*

Pensylvanicus is so spelled (in most plant names) partly because Pennsylvania was also often written with the single "n" in early times, partly because in Latinizing such a name as "Penn" it was customary to reduce the double letter to one. A few geographic words may not be at once recognizable: *novaeangliae*, genitive case of *Nova Anglia* (New England); *ludovicianus* (of Louisiana, Ludovic being Ludwig or Louis); the town of York in Roman Britain was Eboracum—New York is therefore *Novum Eboracum* or *Noveboracum*, whence *noveboracensis.*

Besides the above more or less precise terms, several words are more general in their indication: *australis* (southern); *borealis* and *septentrionalis* (northern); *occidentalis* (western); *orientalis* (eastern).

The very common adjectives *canadensis* and *missouriensis* must not be interpreted in their modern sense. Many species labeled *canadensis* occur widely through the United States; when they were named, "Canada" meant almost every place west of the Appalachians. Similarly, *missouriensis* often referred to the vast territory watered by the Missouri River. Even "Louisiana" was often taken to include most of the country west of the Mississippi, as "upper Louisiana."

Words That Describe the Sort of Place Where Plants Grow

aquaticus, aquatilis, in water *(aqua)*.
arenicola, on sand *(arena); -cola* means "inhabitant" and does not change ending with gender or number; compare *saxicola.*
arvensis, in fields *(arva)*.
campestris, in plains *(campi)*.
maritimus, by the sea *(mare)*.
montanus, in mountains *(montes)*.
palustris, in swamps *(paludes)*.
pratensis, in meadows *(prata)*.
riparius, on river banks *(ripae)*.
sativus, cultivated.
saxicola, on rocks *(saxa)*; compare *arenicola.*
sylvestris, sylvaticus, in woods *(sylvae)*; strictly, should be *silvestris, silvaticus*, but medieval Latin was not classical.

Words That Designate Color

albidus, albus, white.
atropurpureus, dark purple, almost black *(ater)*.
aureus, golden.
azureus, blue.
bicolor, with two colors.
canescens, whitish or becoming whitish (usually with white hairs).
coccineus, scarlet.
concolor, the same color on both sides (of a leaf).
cyaneus, blue.
discolor, with different colors on both sides (of a leaf).
flavus, flavulus, yellow.
fulvus, tawny.
glaucus, whitish with a bloom.
luteus, yellow.
maculatus, spotted.
niger, black.
pallidus, pale.
purpureus, purple; the classical purple was what we call crimson; botanists still use the word in the classical sense.
roseus, rose.
ruber, red.
sanguineus, blood-red.
viridis, viridescens, green, becoming green.
violaceus, violet.

Words That Describe the Shapes and Margins of Leaves

acuminatus, tapering (with concave sides) to a point.
acutus, sharp-pointed.
amplexicaulis, embracing the stem.
angustifolius, with narrow leaves.
bifidus, cleft into two.
cordatus, cordifolius, heart-shaped, i.e. indented at the base; the heart is upside-down.
ellipticus, elliptic.
incisus, incised; deeply cut into sharp teeth.
integer, integerrimus, entire, i.e. the margins without teeth or notches.
laciniatus, deeply cut, jagged.
lanceolatus, narrow, pointed, broadest between middle and base.
latifolius, with broad leaves.
linearis, narrow with parallel sides.
linifolius, with leaves like those of *Linum,* flax.
ob-, upside-down; e.g. *obovatus,* ovate with the broader part outward; but *obtusus,* blunt.
ovalifolius, with oval leaves; sides parallel, ends round.
ovatus, ovate, egg-shaped; broadest between middle and base.
palmatus, divided or lobed with parts extending from a common central part or point.
perfoliatus, the stem growing through *(per)* the leaf or pair of joined leaves *(folia).*
pinnatifidus, pinnately cleft but not divided to the midrib.
pinnatus, divided or cleft or lobed into parts arranged along the sides of a central part or midrib.
renifolius, with kidney-shaped leaves.
reniformis, kidney-shaped, i.e. broader than long, with an indentation at the point of attachment.
rotundifolius, with round leaves.
sagittifolius, with arrowhead-shaped leaves.
serratus, saw-toothed, the teeth pointing forward.
sinuatus, with edges curving in and out.
tenuifolius, with narrow leaves.
trifidus, cleft into three.
undulatus, with wavy margins.

Words That Describe the Surfaces of Leaves and Stems

asper, rough.
barbatus, bearded, i.e. with a tuft of long hairs.
ciliatus, fringed with hairs.
glaber, smooth.
hirsutus, hirsute; with coarse hairs.
hirtellus, with coarse but short hairs.
hispidus, bristly.
horridus, horridulus, prickly.
laevis, smooth.
lanatus, lanuginosus, lanulosus, woolly.
mollis, soft (with soft hairs).
pilosus, with long hairs.
pubescens, downy.
scaber, scaberrimus, rough, very rough.
tomentosus, with short tangled hairs.
villosus, shaggy with long hairs.

Words That Describe General Appearance and Manner of Growth

acaulis, without (visible) stem.
bulbosus, growing from or possessing a bulb or bulbs.
erectus, standing erect.
frondosus, leafy.
fruticosus, shrubby.
gracilis, slender.
humilis, low.
nudicaulis, with nude, i.e. leafless, stem.
procumbens, bent down and trailing.
prostratus, lying on the ground.
pumilus, dwarf.
ramosus, branching.
repens, reptans, creeping. (Compare "reptile.")
rigidus, stiff.
scandens, climbing.
strictus, straight, erect.
tenellus, tenuis, slender.
tuberosus, growing from or forming a tuber or tubers.

Words That Denote Various Attributes

alternifolius, having "alternate" leaves, i.e. leaves borne singly.
annuus, annual; growing from seed to flower in one season.
aromaticus, aromatic.
autumnalis, flowering in autumn.
biennis, biennial; forming leaves the first season of growth, flowers the second.
capillaris, hairlike; very slender.
cernuus, "nodding" or drooping.
citriodorus, having the odor of citrus.
communis, common.
cristatus, crested.
elongatus, elongated.
filiformis, threadlike.
fimbriatus, fringed, i.e. the edges cut into narrow teeth.
gramineus, graminifolius, like a grass *(gramen),* with grasslike leaves.
heterophyllus, with leaves of different forms or colors.
inflatus, inflated; expanded, with space inside.
nutans, "nodding" or drooping.
officinalis, "of the shops," i.e. used commercially.
pachypodus, with thick stalks.
perennis, perennial; growing and flowering through successive years.
pulchellus, beautiful.
rugosus, wrinkled.
sempervirens, evergreen.
sessilifolius, -florus, with leaves, flowers, lacking stalks.
setaceus, bristle-like.
spectabilis, handsome, showy.
squarrosus, "rough," i.e. having the tips of leaves, bracts, etc., bent out and down.
striatus, marked with lines.
suaveolens, sweet-smelling.
tinctorius, used in dyeing.
vernus, flowering in spring.
vulgaris, common.

Flower Stamps from the United States

The following statement, edited to fit our space here, was originally prepared in the form of an attractive pamphlet and distributed widely among botanists by Dr. William L. Stern, Chairman, Commemorative Stamp Committee, XI International Botanical Congress, Smithsonian Institution, Washington, D. C. 20560. We at The New York Botanical Garden warmly endorse this idea because it has a great potential for arousing and augmenting interest in plants. In a sense, some precedent was set at the X International Botanical Congress, held in Edinburgh in 1964, for which the British Government issued a major series of stunningly beautiful flower stamps. We strongly recommend that everyone who finds himself in sympathy with the ideas proposed below write at once to Dr. Stern or directly to the Postmaster General.

The U. S. Post Office Department, through the Bureau of Printing and Engraving, can produce the finest and most beautiful postage stamps in the world. It scarcely tapped this potential in the design and production of the ten existing stamps whose subjects may be classed as botanical or horticultural. A proposal is being prepared requesting the authorization for a commemorative sheet of superb flower stamps. Endorsement of this proposal is sought from every interested person, organization, and institution throughout the United States. The Post Office Department strives to honor proposals that represent, among other requirements, the feelings of the greatest segment of our populace. Few men of the President's Cabinet are more sensitive to the political importance of the public than is the Postmaster General. Hence, strong public endorsement is essential to our success. The situation on the new flower stamps is as follows:

1. The XI International Botanical Congress will meet in Seattle, Washington, in August, 1969. It will be the first time in history that this Congress has been held in this country. It will attract thousands of botanists and horticulturists. The 1969 International Botanical Congress is a most appropriate event for our Post Office Department to commemorate with a set of flower stamps.

2. It is proposed that the Department authorize one commemorative sheet of fifty double-size stamps of vertical design, with a different design for each horizontal row: five stamp designs on the one sheet. This will permit the production of a stamp bearing a plant motif chosen as typical for each quadrant of the country, plus a fifth depicting the seal of the XI Botanical Congress. The production in the United States of a multi-design sheet is not novel — the sheet of U. S. Christmas stamps for 1965 presented four subjects on as many stamps.

3. As reported in *Horticulture* magazine, August, 1966, "because the occasion for this commemorative recognition is a convention of botanists, the selected flower or plant must be one that is native to this country. In the regrettable absence of a national flower, it is agreed that subjects native to the divergent climatic areas of the country be used."

4. The subjects to represent the four sections have been chosen by ballot, and reflect the careful judgment of persons knowledgeable of the flora concerned in each area. Designs for the proposed stamps are in progress, and each of the four subjects is reproduced here. They are:

NORTHEASTERN UNITED STATES: the showy lady-slipper, *Cypripedium reginae,* an orchid native to woodland bogs.

SOUTHEASTERN UNITED STATES: the Franklinia tree, *Franklinia alatamaha,* discovered by Bartram in western Georgia, named for Benjamin Franklin; now lost as a member of our native flora but widely cultivated for its showy flowers.

NORTHWESTERN UNITED STATES: the Douglas-fir, *Pseudotsuga menziesii,* perhaps the best known and most important timber tree in America; while not important for its flowers, it is distinguished by its unusual cones.

SOUTHWESTERN UNITED STATES: the ocotillo, known also as coachwhip and vine-cactus, *Fouquieria splendens,* a showy desert shrub with scarlet flowers borne in great profusion.

5. The decision to request four different flowers reflects the virtual impossibility of agreement on any one native plant for the country as a whole. Our country is too vast and climatically variable. Persons who would prefer other selections than those agreed on are reminded that (a) the purpose is to persuade our government that a superb full color sheet of flower stamps is due the American public; (b) a united front of support is essential; and (c) this is the time for unity of purpose.

The objective is to assure that this country will issue, for the first time in its history, a selection of accurate, beautiful flower stamps in full color.

Conversations on Ecology XIX

By Daniel Smiley

In this continuing exchange of correspondence between Dr. Pierre Dansereau, Senior Curator of Ecology at The New York Botanical Garden, and conservationists and other ecologists, Daniel Smiley records "a beautiful example of an ecosystem previously disturbed by man adjusting itself to a foreign insect through biological controls, without human help except that of letting nature take its course."

Lake Mohonk Mountain House
Mohonk Lake, New Paltz, New York
December 10, 1966

Dr. Pierre Dansereau
The New York Botanical Garden
Bronx, New York 10458

Dear Pierre:

The problems and responsibilities of conservation on privately owned land seem to be less well known, even among conservationists, than are those of public parks and preserves. Mohonk's 7500 acres may serve as an illustration. This tract of mountain ridge, only 90 miles from New York City, has been acquired by my family over a period of nearly 100 years. As a private natural area it has, through the years, served our resort guests and the general public for recreation and inspiration.

With population *increasing* and open space *decreasing*, large tracts of non-public land near population centers can no longer be a law unto themselves. Man's past relation to soil, vegetation, and wildlife continues to influence the present. And these ecological relationships do not stop at property lines. Man thinks of himself as being able to *control* nature, but most of us do not understand the ramifications of our domineering activities outdoors. Nor do we feel any moral responsibility for upsetting natural processes, or for setting in motion secondary effects that may be detrimental to humans. We have assumed attitudes that the Greeks designated as *hubris:* the deadly arrogance of men who had lost their roots.

For four generations the Smiley family has sought to apply to land management the principles of conservation, as its concepts have evolved. This has led to policies that some people, and even governmental agencies, felt were not in the public interest.

Our recent experience with widespread forest tree defoliation by gypsy moth [*Porthetria dispar*] caterpillars is an interesting example of the complexity of land management decisions and their ramifications in human affairs beyond a geographical area itself. Doubtless you are familiar with the depredations of the larvae of this moth in parts of New England, where the people have suffered from it for nearly a century. Here in Ulster County, New York, the insect has intruded itself on the landscape since 1930. A brief review of the situation may serve to emphasize how a seemingly simple problem of ecology gets involved with human economy and spiritual values.

In 1869 a scientist near Boston imported from Europe a moth that he hoped to cross with the Asiatic silkworm, and thus start a lucrative silk industry in America. A high wind destroyed the screened cages and the imported moths escaped. State authorities were warned of the potential danger but they did nothing. After a few years, defoliation of trees was noted. Still nothing was done about the insect, until damage to trees was widespread; since then, control efforts have continued to be too little and too late.

By 1924 the southern half of New England was infested. A "barrier zone" — approximately the Hudson River Valley — was designated. Within this zone a laborious tree-by-tree search for egg clusters showed where spring spraying (from the ground) with lead arsenate would generally reduce the number of larvae feeding on newly formed tree leaves.

The gypsy moth overwinters in eggs, hatches to caterpillars in May, and pupates in June. The adults transform in July. The females are unable to fly because they are so heavy with eggs; however, their scent attracts the males from as far as three miles away. The gypsy moth is destructive in its caterpillar stage, when it eats the leaves of many kinds of trees. Large numbers of caterpillars may completely defoliate a forest. However, the trees leaf out again, even in these dry years. And, as you well know, the defoliation does not kill most trees, unless it is repeated several times. It has been interesting to confirm the New England observation that the oaks and associated species *on dry ridges* are most subject to gypsy moth damage. As one walked from a rocky ridge down into a narrow stream

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valley, one could see that the defoliation decreased, only to increase again on the opposite side.

Except for unintentional transfer of egg masses by humans, the chief means by which the gypsy moth spreads is purely an accidental occurrence, but like so many other natural processes it seems to "work." *If* during the few days when the little caterpillars are hanging on their silk threads there happens to be a strong wind, it may lift them like balloon spiders and carry them several miles. *If* the young larvae fall on trees of favored species unoccupied by gypsy moths, a new colony may be started. It takes only one Adam and one Eve in a new Eden to produce the one egg mass (of each female) that, if it survives the winter, may start a new community.

Hazards in the life cycle of the gypsy moth are numerous. Some are natural hazards, others are interposed by man. Eggs may be lost to winter cold, disease, insect parasites, birds, and mammals; larvae and adult moths encounter similar risks. Man tries to control the moths by poisoning the leaves on which the caterpillars feed.

Up to 1954, local infestations west of the Hudson had been found by laborious scouting and test trapping of male moths by state and federal personnel. These infestations were fairly well controlled from the ground. In 1954, at just the "right time" in the life of the young caterpillars, strong easterly winds (not a hurricane) picked up thousands of tiny balloonists from east of the Hudson and broadcast them over parts of Ulster and Greene counties. By 1956 there were many gypsy moths throughout the Shawangunks, but nowhere were there so many that defoliation was noticeable.

Early in 1957 the U. S. Department of Agriculture decided that the danger from this insect was great enough to warrant spending some $5 million to aerial spray 3 million acres in the Northeast. This was to "wipe out" the insect; previously, the states had attempted only to control it. DDT was the poison used. Reasonable efforts were made to avoid spraying bodies of water, but drift apparently carried the chemical to ponds where I found several hundred dead fish and frogs within a few days. By fall of 1957 the DDT controversy had started. The federal agencies claimed completely successful eradication of the gypsy moth. Conservationists and farmers stated that the insect was not a sufficient problem to justify the great damage that DDT aerial spraying did to agriculture and wildlife.

In 1964 we had the first extensive forest tree defoliation in the Shawangunks; all the defoliation was on dry ridges. I estimated that several hundred acres of Mohonk woodlands were stripped sufficiently to be noticeable from a distance.

During June 1965 the gypsy moth defoliation reached thousands of acres in Ulster County, in spite of some spraying which those in charge stated was too little and too late because of lack of money. Public indignation over the "destruction" of the forests reached the point where local township meetings were called. I was on the panel for two of them and explained the ecological background of the insect, which indicated that there should be *no* spraying, except in city parks and around homes. By fall there was pressure on politicians for more spraying of the forests. Yet, at the same time, there was an undercurrent of strong concern that further insecticide contamination of our forest environment should be avoided.

Before telling you about the unpredicted developments of 1966, I want to summarize what has gone before and develop some ecosystem concepts. My 30 years of personal experience with the gypsy moth problem in Ulster County lead me to say the following: knowledge about the moth and its control is greater than ever before; valiant and honest efforts have been made by federal and state technical people to control the insect; great sums of public money have been spent; increasing concern is felt by the general public over the possible secondary (ecological) effects of the control chemicals used; *and gypsy moths are now present in a wider area of Ulster County than ever before!* Happily, the picture is not so dark as the above summary might make us believe; to accept my claim requires an open mind and an adventure in ecological understanding.

Before I suggest an ecological approach to the relationship of the gypsy moth to man, I would like to review for you my concept of the recent vegetational history of eastern Ulster County. As you so well know, the average person erroneously thinks of the "woods" as a fairly stable group of trees, changing only in size, unless despoiled by a lumberman. What was considered proper use of the forests in pioneer days would now be considered abuse. The woods were exploited for fuel (wood and charcoal), hoop poles, tanbark, and lumber with no thought of continuing availability of desirable products. Large areas, some of them of very low fertility, were cleared for agriculture. These are now in various stages of return to mature forests through natural sequences of plant species which our forester friends generalize under the name "pioneer succession." Fire has been an influence. And about 1920 the chestnut blight radically changed the composition of many forest stands. The possibility of long range weather cycle influences may be compounding the variables.

Thus, our Ulster County woods (and those at Mohonk are no exception) have had a long series of adjustments forced upon them. There are many players on nature's stage even without man's tampering. If we could come back to visit these Ulster County mountain slopes in a hundred years, we could expect to find different associations of trees than at present. Further, these new mixtures would not be the same on all sites. All of this assumes that forest management will not be practiced, at least on the less productive sites.

Connecticut, though one of the four most densely populated states, still is two-thirds forested. Much of this woodland is similar to that of Ulster County. Connecticut has had the gypsy moth in some abundance for fifty years and it is still clothed in green, with only scattered areas of noticeable defoliation.

Thorough studies of the moth-forest interrelationships have been made by Connecticut ecologists. These studies show that as a *year after year* inhabitant the gypsy moth is *mostly confined* to *oak woods* on thin, poor soil, often on dry ridges. The insect may invade other woodlands during favorable seasons, but it is on the poor sites where it persists in spite of control efforts by man. But even here it tends to reach defoliation levels of population only cyclically.

Oaks have been forest trees since shortly after the last ice age, but with the advent of man their propor-

tionate numbers have increased as pines, hemlocks, and certain hardwoods were selectively cut. On the poor dry sites we now find oak, not because it has *always* been there in abundance, but because it, with the former chestnut, could best withstand the frequent heavy cuttings for fuel. The oaks reproduced readily from sprouts and, due to thick bark, could resist damage from frequent fires.

Thus Connecticut research has found that gypsy moth outbreaks tend to recur primarily on sites where oaks are common but grow poorly because of inferior soil and moisture conditions. Generally no *permanent* damage is done by the moth to timber quality oaks on good sites.

In the light of our present ecological understanding of the gypsy moth and the man-altered environment found in Ulster County, what are the possible treatments of this insect malady introduced by man?

1. New massive aerial sprayings can be attempted. Past experience leaves unanswered the question of how effective they really are, compared to the influences of weather and natural controls. There is increasing evidence that the cheaper and more effective DDT has *extremely* detrimental secondary effects on wildlife and on valuable gypsy moth insect predators and parasites. Sevin is lethal to honey bees, and it may be harmful to other forms of life.

2. A do-nothing policy can be adopted. What might happen? Oaks survive defoliation fairly well, up to two or three times, unless unfavorable weather occurs. Only the older caterpillars can feed on hemlock and pine. Thus gypsy moths are not found in pure stands of conifers because the larvae cannot get started there. Sometimes during population peaks, outbreaks will spill over into hardwood stands on better soil sites. In such instances the trees' resistance and natural enemies tend to minimize the long range damage.

Turning again to the oak-covered dry ridge sites where the moth is most at home, the prediction of ecologists is that oaks, as the dominant species, are probably doomed to decline *anyway*. In the long view they will be replaced largely by other species. The gypsy moth may precipitate this alteration somewhat, but if it were not this insect, in due course the modifying factor could be some other insect, disease, drought, ice storm, or fire. More likely it will be some combination of these factors that will produce the change. Also, it may not happen to large areas all at once. Thus, if we can be philosophical about the insect, we can say that it is just another force of nature entering into an adjustment of vegetation cover for certain areas. Winter deer browse may actually be improved by repeated defoliation of taller trees, because low vegetation receives added light and fertilizer (in the frass) in areas subjected to defoliation. It is this low vegetation that the deer feed upon.

In early spring this year [1966] the count of egg masses per acre was very high in large areas of the Shawangunks and in other parts of Ulster County. It was well above the 500-per-acre minimum for which the New York State Conservation Department currently sprays forested areas. There were many demands for spraying and a considerable acreage was treated with a carbamate (Sevin). I do not know how effective this was generally.

Mohonk lands were *not* sprayed, at our request. About two-thirds of our 7500 acres were defoliated by gypsy moth caterpillars this year. There were complaints from our guests because of the caterpillars and the unsightliness for a month, until the trees leafed out again. There were even comments from neighbors in the valley: "It is your mountain but it is our view."

As the caterpillars began to pupate at Mohonk, very interesting symptoms appeared. Innumerable caterpillars fell to the ground, seemed to grow smaller and exhibited a typical bushy appearance, and later died without ever pupating. Vast numbers did pupate but the cases were small. When it was time for transformation to moths, a few males appeared and were noticeable for just a few days. Almost *no* female moths could be found. This literal decimation of population came, I believe, from the combined effects of disease (probably wilt) and parasites (wasps and flies). At this time it is hard to find an egg mass near Mohonk, so I believe we will have no trouble next spring [1967]. Our forest leafed out again — with spring green in late summer. A few of our trees, especially on dry sites, have died, largely, I believe, because of drought during five growing seasons. The defoliation may have been a minor contributing factor.

It seems that here is a beautiful example of an ecosystem previously disturbed by man adjusting itself to a foreign insect through biological controls, without human help except that of letting nature take its course.

Two interesting scientific benefits have accrued from Mohonk's no-spray policy: technicians from the U. S. Department of Agriculture collected thousands of pupae here for a research project, and a world-famous authority on parasitic wasps came to Mohonk to collect because it was a large area of unsprayed forest.

Civilization as well as science has progressed since the time of the Greeks. But have the policy-determining citizens of our democracy lost their "roots" through separation from the soil and nature? Unless they appreciate the interrelationships of plants, insects, animals, *and* mankind, how can they make wise value judgments when confronted with conflicts of human interest? Is this problem an ecological one, a mental one, or a spiritual one? If an integration of these forces can be achieved, does not the owner of a private park have a special opportunity to demonstrate land management with ecological insight and moral responsibility?

Most sincerely,

Daniel Smiley

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HOLLY

By Dorothy Ebel Hansell

HOLLY at the White House, holly in highway beautification, and holly in research were the principal topics at the 41st meeting of the Holly Society of America, held at Easton, Maryland, in November 1966.

Holly at the White House

Of the 503 trees, shrubs, and hedges on the grounds of the White House, 104 are individual hollies or holly hedges. Mrs. Larry Livingston and her husband (who is the Holly Society's president) toured the White House grounds "to look for hollies, of course," and they "found them in impressive numbers."

"All the most familiar species grown in the Middle Atlantic region are represented, with the exception of *Ilex pernyi*," reported Mrs. Livingston. "The American holly, *I. opaca*, predominates, as one would expect. It is used as a specimen, in groups alone or combined with other plants, and to screen private areas such as the tennis courts.

"In the little formal garden, which is dedicated to Jacqueline Kennedy, 10 specimens of *I. opaca*, trimmed to a simple topiary pattern, emphasize the 10 rectangular, boxwood-bordered beds of seasonal bulbs or annuals which are featured in this charming garden. Japanese holly, *I. crenata*, which is given a prominent place in the general plan, is used as a dwarf hedge along the gravel paths.

"A well-trimmed hedge of Japanese holly curves around the window at the end of the President's oval office. One end of the wall is defined by a low, wide specimen of English holly, *I. aquifolium*, and at the other end, against an angle in the wall, is a tall, narrow holly which has become somewhat rare. Called 'Topeli', it is considered to be a hybrid between *I. opaca* and *I. cassine*.

"The roof of the West Colonnade, which leads from the Executive Mansion to the President's office," continued Mrs. Livingston, "is ornamented by a row of eight large hollies in tubs. This is 'Nellie R. Stevens', presumed to be a natural cross between *I. aquifolium* and *I. cornuta burfordii*. The original tree was discovered on the eastern shore of Maryland at Oxford. Because of its intrinsic beauty, vigorous growth, and hardiness, this holly is being widely accepted as a valuable ornamental plant."

The Chinese holly, *I. cornuta*, is displayed prominently in several spots on the White House grounds, and yaupon, *I. vomitoria*, a desirable southern species, is used as a hedge plant and as a specimen.

Holly in Highway Beautification

Plants useful for highway beautification should qualify on several points: as a screen from highway glare; as a screen to reduce the annoyance of motor and traffic noise between the highway and adjacent areas; as a screen to conceal an undesirable view; to indicate change in alignment of the highway or that an exit, crossover, or other facility is approaching; and to require minimum maintenance.

Under minimum maintenance these factors are important: (1) Does the plant require constant pruning, trimming, spraying, or fertilizing? (2) Is it a fast-growing tree which will have to be replaced soon or will it grow so large as to become a hazard? (3) Will it collect trash blowing along the highway? (4) Will it interfere with drainage? (5) Is the tree adapted to the climate, soil, and other conditions of the particular area?

J. H. McWilliams, Jr., Assistant Chief Engineer of the Delaware State Highway Department, who emphasized the importance of these qualifications in selecting plants for highway beautification, said that certain kinds of holly meet them. American holly, which is the state tree of Delaware, exceeds the 6-inch limit in diameter of trunk on maturity so that it cannot be planted along the highway. It is used, however, in the wider median areas, in scenic strips adjacent to the highway, and in rest areas. This holly is extensively planted around the state office buildings, the Legislative Hall, the Governor's Mansion, and along the curbs and on the center island of the streets in Dover, the capitol of Delaware. Mr. McWilliams suggested that hybridizers develop compact and bushy forms of holly which would act as an arresting device to slow vehicles out of control, as well as add beauty to highways.

To aid Delaware in its highway beautification program Mr. Livingston, with the cooperation of a number of Holly Society members, prepared the following. This valuable information is applicable not only to Delaware but to other states (holly of one kind or another is grown in all but 14 of the 50 states) and to home properties as well as to highway beautification programs.

The Highway Department of Virginia has cleared out underbrush, leaving stands of American holly and pine. This can also be done in Delaware, New

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Jersey, and other states where American holly is native. The Virginia Highway Department is also setting out sizeable specimens of American holly along its highways, where space permits.

"Many varieties of American holly have been developed, far too many to enumerate, but 'Arden', 'Manig', 'Maurice River', 'Miss Helen', 'Old Heavyberry', and 'Judge Brown' are satisfactory in this general area and available from a number of sources. The hybrid 'Nellie R. Stevens', which appears to be hardy and grows rapidly, might be used in trial plantings.

"Chinese hollies vary in their habit of growth but are normally multiple stemmed, with a dense growth of aggressive branches. They range in size from ground-hugging dwarfs to specimens 10 to 12 feet tall. They are not as hardy as the American holly, so the areas in which they may be planted are more limited. 'Hume' is one of the hardier cultivars of *Ilex cornuta.*

"Most varieties of Japanese holly, *Ilex crenata,* are reliably hardy. Their small leaves resemble those of boxwood; their berries are black. They range from low cushion forms to 8-foot specimens. All species of *Ilex* will stand extensive shearing, but this is especially true of *I. crenata,* widely used as a formal or informal hedge plant. It will also do well in damp localities.

"The native deciduous holly, *I. verticillata,* is also adapted to damp situations. Since it would not exceed the 6-inch limit in diameter of trunk at maturity, *I. verticillata* could well be used for highway beautification."

Holly in Research

Ilex is of commercial value as nursery stock for public and private plantings and as orchard trees for harvesting cut material for Christmas decoration. Hence experiment stations are interested in it, with three stations conducting large scale research and others having research projects under way. Dr. D. F. Crossan, Assistant Director of the Delaware Agricultural Experiment Station at Newark, summarized their work, because Holly Society members – both the professional and the amateur growers – are naturally interested in efforts to improve this group of plants.

In the extensive breeding program at the Agricultural Experiment Station at Rutgers – The State University, English and American hollies (*Ilex aquifolium* and *I. opaca*) are being crossed to combine the better foliage and berry characteristics of the former with the winter-hardy feature of the latter. *Ilex crenata, I. glabra, I. serrata,* and *I. verticillata* are also being used in this breeding program. The Experiment Station at the University of Delaware has undertaken the large project of finding the best fertilizing practices for an orchard of American holly and of relating these practices to natural stands in woodlands. After the various fertility treatments, leaf analyses are made. The Oregon State University Experiment Station has been experimenting in an attempt to control the set of berries in commercial cultivars, and making a series of leaf and berry analyses for nutrient elements as they affect fertility.

Washington State University and the Connecticut Experiment Station at New Haven are doing some work on insect control, not continuously but as the problem arises among holly growers. North Carolina State University has limited trials of growth-regulating chemicals to close stomata, thus improving the keeping quality of cut foliage, while Michigan State University and the University of California are experimenting with growth regulators to induce flowering and improve berry set, and the University of Tennessee to control tree size. Elsewhere – at the Ohio Agricultural Research Center, Ohio State University, Pennsylvania State University, the University of Rhode Island, Texas A and M University, Virginia Polytechnic Institute, and Clemson University – the winter hardiness and horticultural characteristics of certain varieties are being evaluated. Several of these stations are also testing, to a greater or lesser degree, herbicides, fertilizers, and antidesiccants as they affect holly. ■

THE NEWSLETTER. In January 1967 The New York Botanical Garden inaugurated a Newsletter to inform its members of news and events of immediate interest. News of lasting and historical interest will continue to be published from time to time in The Garden Journal.

The Newsletter is published 11 times a year—monthly September through June and a July-August issue. It is for members of The New York Botanical Garden only, and is not available by purchase or subscription. See inside front cover of this magazine for membership details.

Book Reviews

THE FRAGRANT YEAR. Scented Plants for Your Garden and Your House

By Helen Van Pelt Wilson and Léonie Bell. 306 pages; 94 illustrations by Léonie Bell; indexed. M. Barrows & Company, Inc., New York, 1967. $10.00.

The range of plants that bring sweet scents close to and into one's home is so extensive that it would take years to acquire and grow them all. Just reading about them excites the senses. The authors have recorded the distinctive perfumes of individual plants as they grow throughout the year, almost week by week. To evolve a method of expressing the fragrance of plants in words, they spent many years comparing the plants in their separate gardens. Then they developed an olfactory vocabulary; in it lies much of the freshness of the book. By avoiding the language of the chemist, to whom the smell of licorice is really that of the anise oil used to flavor licorice products, Mrs. Wilson and Mrs. Bell educate the gardener's nose.

"Comparing our impressions of various scents – the delicate ones discovered only by the searching nose, the freer ones that floated out on the air – we tried to analyze and classify. We often disagreed. Gradually we discovered a wide area of unanimity in identifications, at least enough to make possible the nine classifications that we have used here as the basis for our descriptions of fragrance." Chapter 2, "Classifications of Scents," is illuminating. Starting with Balsamic, found only in the essential oils of leaves of mints, lavender, and other herbs; Spicy, found in leaves and flowers of carnations, pinks, nasturtiums, for instance; Heavy, of a free and penetrating perfume, possibly unpleasant in confinement, represented by jasmine, orange blossom, and gardenia; and Sweet which has three subdivisions including dry, yeasty, and musky, one gets the idea of just how discriminating and familiar with a wide variety of perfumes the authors are. They believe that a "nose" can be educated, though perfumers feel that people are born with the ability to sniff out the refinements of essential oils. Sadly, some people lack a sense of smell. Those who have one gain much pleasure by becoming acquainted with and growing fragrant plants throughout the year.

Having established a language for comparison of scents, the authors take us through the year, starting with fragrant winter shrubs such as Chinese witch-hazel, *Hamamelis mollis,* which blooms in Philadelphia in January. The earlier blooming *H. vernalis,* upon stock of which *H. mollis* is often grafted, is described as having a "sweet yeasty aroma." Chinese witch-hazel has "pure delicious perfume of jonquil" rising from straplike yellow blossoms upon bare stems. It is hardy as far north as Utica, New York, to our knowledge, though the authors mention that near Philadelphia it sometimes fails to bloom if the winter is too cold.

A good deal of historical information is included in the chapter "Just Roses"; it is really a very extensive list of old roses and the most fragrant modern ones. Herb lore and nice hints for keeping insects at bay are sprinkled among the cultural details for the species described in "Aromatic Herbal Scents." A few more chapter titles will give an idea of the range of plants catalogued in *The Fragrant Year:* "Spring Scents of Shrubs and Trees"; "From Early Bulbs and Small Perennials"; "Pinks, Peonies, and Iris"; "Fragrant Lilies, Old and New"; "A Midsummer Night's Garden"; "For Cool Window Gardens." "Pleasures of Potpourri" gives detailed directions for both the moist and dry methods of making fragrant mixtures that last for years.

The Fragrant Year is a book to refer to repeatedly; one cannot take in all its delights in the first reading. Here are dozens of plants that add more than color to the garden in any given month. The added grace note of fragrance in house plants is scored in the chapter "Fragrant Schedule for a Living Room." I shall put *Brunfelsia latifolia,* or "kiss-me-quick," high on my list of fragrant plants to try next winter. It grows in a cool window garden, "making a little spreading tree seldom taller than two feet with clear lavender-blue blossoms." Mrs. Wilson types the fragrance as a blend of gardenia-clove-jasmine, strongest at night.

– GERTRUDE B. FOSTER

(Mrs. Foster is editor of *The Herb Grower Magazine* and author of the book, *Herbs for Every Garden.)*

THE MAGIC WORLD OF ROSES

By Matthew A. R. Bassity. 224 pages; 53 color plates, 89 black-and-white photo graphs, 16 drawings; indexed. Hearthside Press, Inc., New York, 1966. $6.95.

I love this book; it is an enchanting affair that I read with the greatest pleasure. It has many, many things I have not seen before.

Decidedly different from most rose books, *The Magic World of Roses* will inspire the beginner and delight the confirmed rosarian. Basic rose culture is covered briefly but adequately, with special attention to varying climatic conditions. More emphasis is put on enjoying roses. Paraphrasing Gertrude Stein, Mr. Bassity says, "A rose is historic is a legend is a garden is a bouquet is a picture is forever." He then proceeds to deal with these aspects, using such felicitous descriptions as ". . a garden of roses is a fragrant piece of heaven."

After showing the magic of roses in both history and legend, the book goes to the garden and to ways of using roses. There is excellent treatment of rose hybridization and production, rose arrangements, roses to eat, drink, or smell, and rose photography. There are long lists of rose awards and of rose gardens open to the public. The chapter on judging and classification of roses contains the detailed Nicolas Classification Chart, which I had not seen in print before.

This book is a perfect gift for one who already has an extensive rose library, and equally good for one just being initiated into the delights and rewards of roses. I recommend it for reading pleasure and for unusual information.

– CYNTHIA WESTCOTT

(Dr. Westcott, "The Plant Doctor," is a plant pathologist; her books include *The Gardener's Bug Book, Are You Your Garden's Worst Pest?,* and *Anyone Can Grow Roses.)*

BIOLOGY

By Karl von Frisch (translated by Jane M. Oppenheimer). 516 pages; illustrated; indexed. Harper and Row, New York, 1965. $12.95.

The publication of this handsomely produced and profusely illustrated volume is a major event for biological studies. Here at last is an authoritative and readable survey of biology that can be warmly recommended to the general reader and to the amateur naturalist. The author, who is Professor Emeritus at the University of Munich, is a biologist of great distinction; he is well know for his work on the changes of color in animals, the physiology of senses in fishes and insects, and the color sense and chemical senses of bees in relation to their behavior. He is widely recognized also as an outstanding writer on science for the layman, and a number of his books, including *Man and the Living World, The Dancing Bees,* and *Ten Little Housemates,* have enjoyed well-deserved popularity.

Although written originally as a textbook for use in German schools, this book is far more than a text. As a comprehensive introduction to the science of life with strong emphasis on natural history it is in many ways unique. The author brings his broad knowledge and profound insight to bear on the entire range of biological information and he presents in this volume a well-balanced account of the world of living organisms in language intelligible to readers with little or no scientific background. As Paul Weiss writes in the Foreword: "The modesty of presentation conceals the fact that many of the facts and principles described stem from the ingenuity and versatility of the author himself. What he cannot conceal, however, is his sovereign command and personal love of the whole field of biology, from the molecular elements all the way up to social group behavior. It is this personal touch that makes the book read like a lively story – not a pedantic text."

The first three chapters, comprising about half the book, are devoted to a broad survey of structure and function. The cell as the common unit of construction in plants and animals, the assemblages or aggregations of similar cells to form tissues of various kinds, and organs, including the skin, the skeleton, organs of locomotion, nutrition and metabolism, respiratory and circulatory organs, sense organs, the nervous system, endocrine glands and hormones, are all discussed. The author then turns to the subjects of adaptation to environment, interrelationships among living organisms, reproduction and development. The book is rounded off by two substantial chapters covering the basic ideas of heredity and evolution.

The book owes much to the numerous and beautiful illustrations, mainly by Ludwig Binder, an outstanding medical illustrator, who combines meticulous accuracy with the skillful use of color for the vivid elucidation of detail. The translator, Professor Jane M. Oppenheimer of Bryn Mawr College, has succeeded admirably in reflecting the meaning and spirit of the original. The author pays her warm tribute in his Preface: "Professor Oppenheimer undertook to make a factually accurate translation of the text, but she has succeeded in doing more. The quality of her translation is so excellent that the English version reads like a beautifully written original work, and not like a translation at all." A carefully selected and annotated list of books for suggested additional reading is appended to the text. The volume is fully indexed.

This stimulating book is probably the best available up-to-date and all-round introduction to the subject for everyone with intellectual curiosity. It undoubtedly provides what every good amateur naturalist should know about biology.

— MULFORD MARTIN

HERBAL HANDBOOK FOR EVERYONE

By Juliette de Bairacli Levy. 178 pages; indexed. Charles T. Branford Co., Newton Centre, Mass., 1967. $6.75.

Obviously, this author has been touched by the pleas of those who, having seen her previous *Herbal Handbook for Dogs* or *Herbal Handbook for Farm and Stable,* have begged plaintively for a Herbal Handbook for *Husbands!* Treatments for us all – for minor ills which might lead to greater – specify herbs in simple methods which may be within the scope of the home, before professional medication is indicated. This brief volume covers a wide range of material, including the growing, gathering, and drying of herbs; simple medicinal uses; and culinary and cosmetic recipes.

Miss Levy believes, with many wise men of the past, that the Lord has caused plants to grow upon the earth for the health and service of men. Those conscious of the danger of poison sprays for farm and orchard will be interested in her advice on herbal insecticides. She credits a marvelous harvest of grapes and of corn to the incorporation of sage with manure and wood ashes. Sage to us is pork seasoning – and yet the Mary Matilda Harper hair tonic, famous for years as a scalp treatment, has sage as a basic ingredient. Vapo Rub includes sage to relieve stuffy breathing. I can admit the efficacy of raw garlic in averting the common cold if it is taken at the very onset of the cold. Extremely antiseptic, garlic is also beneficial to dogs when it is mixed with their food.

In Miss Levy's introduction we read that herbs are man's rightful inheritance for the cure of his ills and those of his land and his animals. Surely these simple and age-old remedies can make our involved and crowded present-day living more comfortable and bearable. They do – merely the reading of them – give us an appreciation of the earth and all that grows upon it.

— ELIZABETH REMSEN VAN BRUNT

REPRODUCTIVE BIOLOGY AND TAXONOMY OF VASCULAR PLANTS

Edited by J. G. Hawkes. 183 pages; illustrated; indexed. Pergamon Press, New York, 1966. $5.00.

This book consists of a set of papers given at a conference of the Botanical Society of the British Isles in 1965. Fifteen authors are represented – 13 British, 1 (van der Pijl) Dutch, and 1 (Nygren) Swedish. The papers are grouped under five headings: 1, breeding systems, variation, and adaptation; 2, reproductive biology in relation to plant breeding; 3, pollination mechanisms; 4, reproductive capacity and plant distribution; 5, apomixis. The papers are individually interesting and significant, but in this case the whole equals only the sum of its parts. The book will be a useful reference in botanical libraries. — ARTHUR CRONQUIST

GENETICS OF SEXUALITY IN HIGHER FUNGI

By John R. Raper. 283 pages; illustrated; indexed. Ronald Press Co., New York, 1966. $12.00.

The "higher fungi" of the title are a large group comprising what are commonly known as gill fungi, spine fungi, club fungi, and leather fungi. Mating in this group is controlled by either one or two kinds of genetic factors. Only two members of the higher fungi, one a rotter of wood and the other an inhabitant of dung, have been subjected to extensive genetic analysis. These perforce are the chief subjects of the book. The author and his graduate students at Harvard University, together, have contributed most of the information on the sexual behavior of the wood-rotting fungus. This book is primarily of interest to advanced students of genetics and the fungi. — ALMA W. BARKSDALE

PRINCIPLES OF PLANT BIOCHEMISTRY.

By V. L. Kretovitch (translated from the Russion by T. Z. Nowokowski and A. J. Clarke). Revised and supplemented fourth edition. 454 pages; illustrated; indexed. Pergamon Press, Long Island City, New York, 1966. $15.00.

A good plant biochemistry text would be a welcome addition to the literature. Unfortunately, this book is disappointing. The general arrangement is good, but the text is very uneven. The first six chapters are devoted to an outline of the chemistry of various groups of compounds found in living organisms: proteins, carbohydrates, fats, vitamins, "secondary plant compounds" and enzymes. The last eight chapters treat the dynamic aspects of biochemistry: metabolism of these groups of compounds, fermentation and respiration, etc. Some chapters are better than others but the text in general seems to be composed of a series of flat statements. It lacks flowing style on the one hand, and supporting references on the other. While the plan of its organization is basically good, it does not carry through.

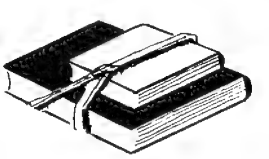
— MARJORIE ANCHEL

THE HEPATICAE AND ANTHOCEROTAE OF NORTH AMERICA EAST OF THE HUNDREDTH MERIDIAN.

By Rudolf M. Schuster. Volume 1; 802 pages; illustrated; indexed. Columbia University Press, New York, 1966. $20.00.

This substantial book is the first of several projected volumes on the liverworts of the North American continent east of the Great Plains from Florida to the Arctic and it represents the first definitive and comprehensive treatment of the hepatics of this vast region. It is a new and completely original work by a widely recognized authority whose independent views have aroused keen interest among students of the bryophytes. Much of the present volume is introductory. It includes an extensive bibliography of over 2900 entries, an historical outline of hepaticology, and a valuable discussion of methodology and basic concepts, structure, cytology, evolution, phylogeny and classification, together with a detailed analysis of the comparative morphology of the vegetative and reproductive structures of the liverworts. Individual discussions and diagnoses of a small number of families, genera, and species bring the initial volume of this monumental work to a conclusion. The book is excellently illustrated with several hundred detailed drawings, most of them prepared by the author, assembled on over 80 composite plates. The volume is fully indexed.

— MULFORD MARTIN



Brief Notes on Recent Books

THE PICTORIAL ENCYCLOPEDIA OF PLANTS AND FLOWERS

By F. A. Novak. 589 pages; illustrated (part color); indexed. Crown Publishers, New York, 1966. $10.00.

An attractive volume containing more than 1100 plant photographs, 49 of them in color. A very brief description of each plant accompanies its photograph. The photos were collected over many years by the author, a Czechoslovakian botanist. Dr. Harold William Rickett, Senior Curator of Botany at The New York Botanical Garden, served as the American consultant to the publication of this work.

ITALIAN GARDENS OF THE RENAISSANCE

By J. C. Shepherd and G. A. Jellicoe. 118 pages; illustrated; indexed. Architectural Book Publishing Co., New York, 1966. $10.95.

This Library Edition represents the third edition of a work first published in 1925. It has been reduced in size from a folio to a quarto; the drawings remain the same size and scale, but the photographs have been reduced. The text has had only slight alteration; it now appears in English, French and German.

The authors present a description of the architecture of Italian gardens, history, design, effect, and a chronology of its development. Twenty-eight Italian villas are described briefly, and each description is accompanied by drawings of the plan of the garden as well as black and white photographs illustrating the highlights of each.

A HISTORY OF GARDEN DESIGN

By Derek Clifford. Revised edition; 252 pages; illustrated, indexed, Frederick A. Praeger, New York, 1966. $16.00.

An attractive volume that traces the development of concepts and practices in garden design from ancient times through the nineteenth century. The approach of the work is conceptual rather than encyclopedic. Specific gardens are used to illustrate points under discussion. Numerous black-and-white illustrations and a bibliography, divided geographically, accompany the text.

ILLUSTRATED ENCYCLOPEDIA OF HOUSE PLANTS

By Violet Stevenson. 95 pages; illustrated; not indexed. D. Van Nostrand, Princeton, N. J., 1966. $3.95.

This attractive work is divided into two parts: The first, a brief introduction to the care and culture of house plants; the second, an alphabetically arranged listing of over two hundred of the more common house plants. Arrangement is by botanical name with cross-references from the common name; no pronunciation is given for the botanical names. Each listing is accompanied by a black and white photograph, a short textual description of the plant, and special horticultural hints. There is also a small section of colored plates.

AT HOME WITH PLANTS

By Elsie Lee. 208 pages; illustrated; indexed. Macmillan Co., New York, 1966. $5.95.

This guide to house plants is divided into two sections: "How to Buy, Care For, and Use Plants" and "A Growers Guide to Plant Cultivation." The first part gives a very general account of cultivation techniques; the second lists in alphabetical order, by botanical name, a number of the more popular house plants. No pronunciation of names is given. The information accompanying the listing varies considerably but generally includes a brief description of the plant, potting soil, growth conditions, and cultural hints. A small section of black and white photographs is included. The book is disappointing in its generalizations, lack of detail, and lack of photographs to illustrate each description.

GROWING BULBS IN THE HOUSE

By Xenia Field. 136 pages; illustrated; indexed. St. Martin's Press, New York, 1966. $3.95.

This small volume gives a detailed, easy-to-follow description of how to grow bulbs indoors. The author, who has written several gardening books, first discusses the culture of bulbs, then classifies specific bulbs according to the ease with which they can be grown – those easily grown by the novice to those requiring considerable knowledge and skill.

FLOWER AND PLANT PRODUCTION IN THE GREENHOUSE

By Kennard S. Nelson. 335 pages; illustrated; indexed. Interstate Printers & Publishers, Danville, Illinois, 1966. $5.95.

A detailed but simply presented nontechnical description of the basic day-to-day operations of commercial greenhouses. The volume is designed for use in conjunction with high school vocational guidance programs. The floriculture industry, greenhouses, techniques and materials, and the major crops of cut flowers and potted plants are discussed.

PETER KALM'S TRAVELS IN NORTH AMERICA; THE ENGLISH VERSION OF 1770.

Edited by Adolph B. Benson. 797 pages (2 volumes); illustrated; indexed. Dover Publications, New York, 1966. Paperback $5.00 per set.

This two-volume reprint of the American edition, first published in 1937, covers the North American travels of Peter Kalm, a Swedish naturalist and student of Carl von Linne (Linnaeus) during the eighteenth century. Peter Kalm was sent to America by the Swedish Academy of Science to gather seeds of plants that would grow well in Sweden. His diary contains a wealth of fact and folklore concerning all aspects of natural history. It also provides an interesting account of life in eighteenth-century America.

A NATURALIST IN NEW ZEALAND

By Mary E. Gillham. 285 pages; illustrated; not indexed. Distributed by Tri-Ocean Books, San Francisco; 1965. $7.45.

The author, an English botanist and ecologist, describes her observations of the natural history of New Zealand made during a year-long visit to that country, when she held an exchange lectureship and wardenship at Massey College. She describes the fauna and flora of the region, giving particular attention to the adaptation of native plants and animals to the invasion of European and other settlers.

THE ATLANTIC SHORE—Human and Natural History

By John Hay and Peter Farb. 246 pages; illustrated; indexed. Harper & Row, New York, 1966. $6.00.

The authors, each an outstanding nature writer, have presented in this work a fascinating account of the natural history of the North Atlantic shore from Long Island to Labrador. Physiography, environment, fauna, flora, and man's relation to and effect upon each are discussed. Fifty natural areas along the North Atlantic coast are listed.

THE HANDBOOK OF BIRDS OF EASTERN NORTH AMERICA

By Frank M. Chapman. 581 pages; illustrated; indexed. Dover Publications , New York, 1966. $3.00.

Reprinted from the second revised edition published in 1939, this remains a standard reference book for ornithologists and amateur "bird watchers" alike. It contains a wealth of information not found in many more recent fieldbooks. A new color chart replaces the 1939 chart. The list of ornithological societies and periodicals has also been brought up-to-date. A number of plates, originally appearing in color, are here reproduced in black and white.

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WALTER SINGER

A New York Botanical Garden Highlight

"May those who follow after you
enjoy unharmed the natives
which find refuge here."
– Guide to the Native Plant Garden

The Native Plant Garden

Since the beginning of this century The New York Botanical Garden has accepted a responsibility to preserve our native flora. An area of the Botanical Garden's 230 acres was designated for this garden in which is planted a representative collection of plants that occur naturally in the northeastern part of the United States. Our Native Plant Garden is in part the preservation of an already existing natural area, and partly the result of a deliberate plan to plant, nurture, and preserve the native plants that are unretrievably disappearing from the face of this earth. Animals can make known their pain or hunger (and we hope someone hears) but plants disappear silently when natural conditions are altered by climatic changes or by marauding land-leveling machines and men.

We know the importance of understanding native flora in all parts of the world and especially of collecting it for the permanent record of the botanical inventory, and the need for ecologists to know what grew or grows where and when.

In the Botanical Garden's Native Plant Garden are woodland and meadow, rocky ledges, a stream, a pond, a bog, and limestone rocks brought in to create the special conditions demanded by plants that need an alkaline soil. An overhead mist system cleans, cools, and humidifies the air and makes it possible to cultivate successfully many wildlings that could not survive city conditions. A rocky pool and waterfall provide additional atmospheric moisture. Extensive preparation of the soil and the atmosphere, and an understanding of the needs of each plant, assure congenial habitats for the many kinds of plants growing here. Many are self-sowing, and we hope that they will perpetuate themselves in this salubrious environment. Hosts of birds – permanent and migratory – find food and cover in this refuge and, as if in thanks, contribute their songs and beauty to the garden.

Mrs. Elizabeth G. Britton, wife of the Botanical Garden's first director, ardently advocated the preservation of wild flowers. In 1901, a fund was received from Olivia and Caroline Phelps Stokes, the interest on which "should always be used for the investigation and preservation of native plants and for bringing the need for such preservation before the public."

A volunteer committee originated the idea of the Native Plant Garden and initiated the raising of funds to achieve it. The committee – Mrs. Percy L. Douglas, Chairman, and Mrs. Edward C. Delafield, Mrs. Ferdinand Eberstadt, Mrs. Thomas Gates, Jr., Randolph C. Harrison, Joseph DeF. Junkin, Dr. Samuel W. Lambert, Jr., Mrs. Madison H. Lewis, Mrs. John E. Lockwood, Mrs. Mary C. Rockefeller, Mrs. Donald B. Straus, and William C. Steere – plans the garden's horticultural development, in cooperation with the horticultural staff of The New York Botanical Garden; and sponsors educational programs on identification, cultivation, propagation, and conservation to broaden the value of the plantings. E.C.C.

GOTTSCHO-SCHLEISNER

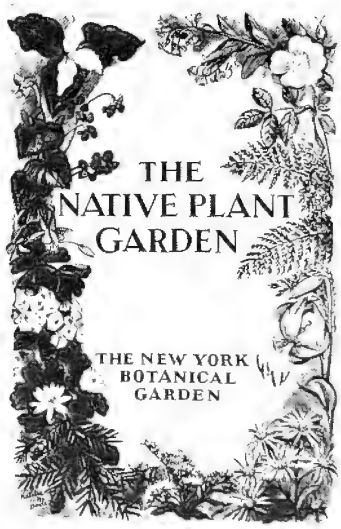
Spring 1967 — snow trillium in the Native Plant Garden.

Left above: A path to stroll in the Native Plant Garden.

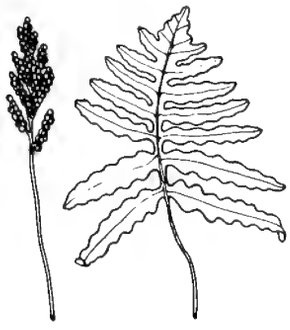
Left: This exhibit simulating the Native Plant Garden won the New York Florists' Club Trophy, and the Federated Garden Clubs of New York State Special Bronze Medal for an outstanding educational exhibit, at the International Flower Show, March 1967.

The Native Plant Garden Committee has published a 48-page booklet, *Guide to the Native Plant Garden,* written by Elizabeth P. Corning. The booklet has a full-color cover and 114 detailed line drawings of native ferns, wild flowers, trees, and shrubs by Natalie H. Davis. Each drawing is accompanied by text that states the English name, the botanical name, the name of the plant's family, a brief description of the plant for easy identification, and an indication that the plant is on the left or the right side of the path as one follows the trail depicted on the map in the center of the booklet. Plant labels in the Native Plant Garden have been numbered to correspond to the numbers used in the Guide. The booklet is not a complete guide to every species growing here, nor is it a botanical textbook. It is a handbook for a self-guided tour, and a valuable, accurate reference work on wild plants.

The cost of producing the booklet was underwritten by Renée du Pont Donaldson; it may be purchased for $1 including postage and mailing. Order as many copies as you like of the *Guide to the Native Plant Garden.* Send order and remittance ($1 per copy) to Native Plant Garden Downtown Office, The New York Botanical Garden, 125 East 65th Street, New York, New York 10021.



SENSITIVE FERN



Onoclea sensibilis

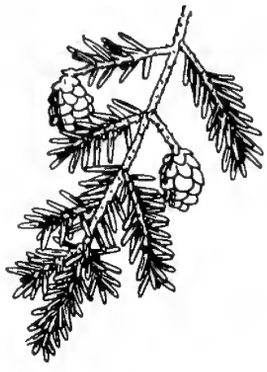
FIRE-PINK

Silene virginica

MONEYWORT

Lysimachia nummularia

HEMLOCK



Tsuga canadensis

INTERRUPTED FERN

Osmunda claytoniana

JACK-IN-THE-PULPIT

Arisaema triphyllum

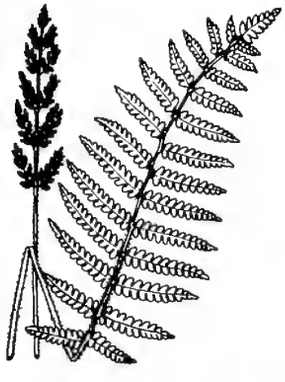
WILD STRAWBERRY

Fragaria virginiana

ARROW-WOOD

Viburnum dentatum

CINNAMON FERN

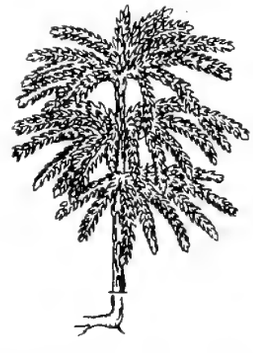


Osmunda cinnamomea

DUTCHMAN'S-BREECHES

Dicentra cucullaria

GROUND-PINE



Lycopodium obscurum

ROSEBAY

Rhododendron maximum

OSTRICH FERN

Matteuccia pensylvanica

MAY-APPLE

Podophyllum peltatum

JOE-PYE-WEED

Eupatorium dubium

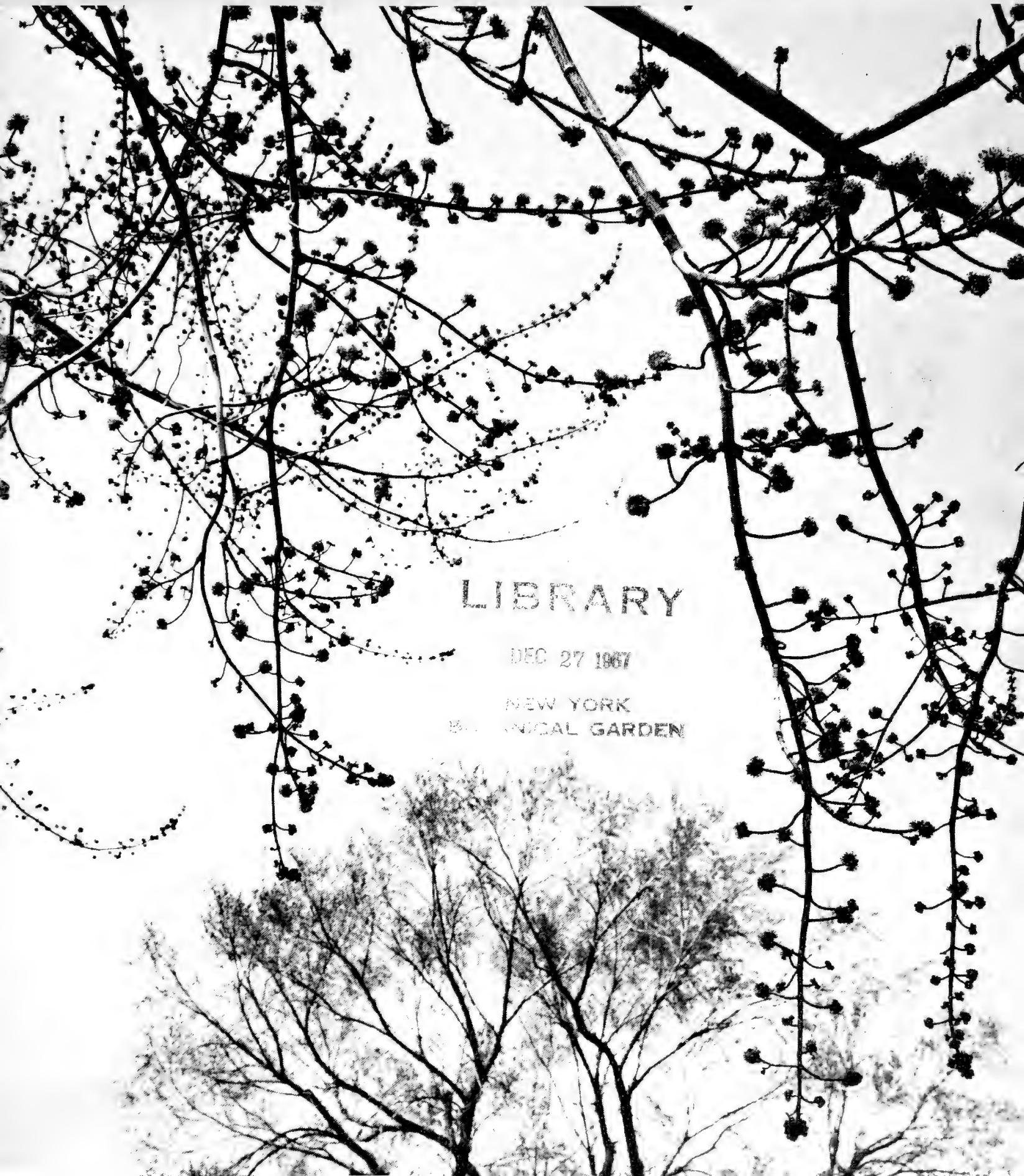
INKBERRY

Ilex glabra

MAY/JUNE and JULY/AUGUST 1967

Garden Journal

THE MAGAZINE ABOUT PLANTS



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Garden Journal

THE MAGAZINE ABOUT PLANTS

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CONTRIBUTIONS TO THE GARDEN JOURNAL • *The Garden Journal* is published for the intelligent layman who has an abiding interest in plants. We welcome offers of articles on any plant subject by professional and amateur botanists, horticulturists, conservationists, educators, naturalists, and gardeners—who can write with authority. We are greatly interested in stories that convey botanical and horticultural developments, discoveries, histories, concepts or ideas, instruction, and news in a non-technical but scientifically accurate manner. We do not usually publish how-to articles for beginners; likewise, we do not usually publish original scientific papers. When proposing an article, briefly explain the subject, what you will say about it, and your qualifications. Address editorial correspondence to Editor, *The Garden Journal,* The New York Botanical Garden, Bronx, New York 10458.

HORTICULTURE:

Challenge and Opportunity

By Harold Roy Fletcher

The setting for this compelling, thought-provoking address was the closing banquet of the XVIIth International Horticultural Congress at the University of Maryland, College Park, Maryland, on August 19, 1966. At the climax of the first International Horticultural Congress ever held in the United States, Dr. Fletcher addressed an audience of five hundred persons from all corners of the world, whose response was overwhelming in admiration and appreciation for this blueprint for the future, this call for action. The theme of the Congress—"The Plant, the Environment, and Man"—was now set in focus, with the final emphasis upon horticulture in its relation to man: human population growth, human needs, the quality of life, scientific resources, plant materials, the tropics and subtropics, horticultural training, and horticultural implementation.

The Garden Journal is honored to publish Dr. Fletcher's address. We echo the sentiments of Dr. Harold B. Tukey, President of the XVIIth International Horticultural Congress: "It is the hope that many will be stirred to move aggressively in the areas that Dr. Fletcher has so vividly revealed."

I seem to remember someone, somewhere, writing or saying something to this effect: that if all men were to talk only on the matters on which they were expert a deathly silence would cover the world. You will appreciate that it would not be my wish to say anything which could reduce this gathering to such a state. Mind you, as a result of what I have read of the Congress Proceedings and as a result of what I have heard at the meetings I have attended, I feel so little expert on anything that I gravely doubt that I could reduce you to this state, even were I to try very hard. Even so, I do not propose to take any chances and, very rashly I suppose, I will venture into matters which are not really my concern — or, if they are my concern, then they are so in the sense that they should be the concern of everyone; and I take my thesis from the heading of an article written by our President, Dr. H. B. Tukey, in the March 1964 issue of *Chronica Horticulturae* — "Challenge and Opportunity." Equally well could I have taken my thesis from the title of the paper which was distributed to all members of the Tenth International Botanical Congress meeting in Edinburgh, in August 1964 — a paper written by Professor Riker on behalf of The National Academy of Sciences of the U. S. A. and entitled "Some Opportunities and Challenges in the Plant Sciences." However, Dr. Tukey clearly has the priority.

But this apart; in view of the fact that in her splendid message to the Congress at its opening, our Honorary President, Mrs. Lyndon Baines Johnson, spoke of the challenges and opportunities in horticulture today, it is clearly appropriate that I speak on this same matter this evening, for Dr. Tukey tells me that he regards this banquet as the real end of the Congress. For those of you who may be interested, it would appear that the closing session tomorrow morning will be the briefest on record.

Everyone attending this Congress is aware of the tremendous strides which horticulture — almost every aspect of it — has taken in the course of this century. Almost everywhere, throughout the temperate regions of the world — throughout the predominantly industrialized and wealthy north — there has been the development of horticultural research stations, horticultural advisory services, increased horticultural educational facilities, increased specialization in the horticultural industry with vastly improved mechanization of production methods. Especially has there been an increase in basic scientific knowledge and technology — and it is obvious that the future will yield far greater increases to such knowledge.

Who doubts for a moment, for instance, that there will be further additions to the bewildering array of new weed killers, fungicides and insecticides, systemic and otherwise; that there will be additions to our knowledge of plant disease control by antibiotics; that disease-resistant cultivars of fruits, vegetables, and ornamentals, with other desirable qualities, will be bred; additions to our knowledge of the mechanism by which light, for instance, controls such plant responses as the germination of light-sensitive seeds, the growth of seedlings and the regulation of flowering? Who doubts that leaf analysis techniques will add to our knowledge of tree nutrition; that radioactive chemicals will be used more and more to trace the absorption, translocation, and utilisation of nutrients in plants; that gamma radiation will be used to modify plant growth and effect gene changes; that growth regulators will be in-

creasingly used to hybridise plants which previously have refused to cross; that fertile hybrids will be induced from chemically produced polyploids? Such advances in our knowledge are absolutely inevitable. And so are many others due to the filling in of the gaps in our basic knowledge by the discoveries of physiology, biochemistry, biophysics, molecular genetics, cellular biology, etc. At any rate, they are inevitable so long as horticulturists of the future have a wider training in these disciplines, or at least have a wider knowledge of the results of the researches of these disciplines, and are equipped to *apply* this basic knowledge to horticultural science and technology.

All this increase in knowledge has been put, and will continue to be put, to human benefit; to decreasing the cost of production; to increasing productivity in plants; to increasing output per man. We are all aware of the fact that in some parts of the world, in Britain for instance, the horticultural industry has increased in efficiency to the extent that crop production per acre has improved by as much as 50 per cent in the last twenty-five years. I believe that in the United States in 1940, a farmer fed himself and eleven others; twenty-six years later he feeds himself and twenty-eight others. However, just as the rate of food production increases, so does the rate of population growth increase. So far, in the developed countries, the rate of increase of the former has more than matched that of the latter – and this in spite of the fact that the total of cultivated acreage has declined somewhat in recent years.

However, let there be no complacency—for there is no cause for such. I understand that during the past ten years the population of California has increased by about five millions; that during the next ten years it is expected to increase by about six millions; that during the next ten years the population of the U.S.A. as a whole is expected to increase by about thirty millions; that each additional million takes about 100,000 acres of cropland out of cultivation. At the same time, I also understand that in this wealthy U.S.A. there are some 34 million *poor* people; that poverty affects some 40 per cent of the nation's coloured population; that there are fifteen million children and over five million old people *below* the poverty level; that two thousand Americans die of malnutrition each year. I'm aware that this last figure

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is only one in 100,000. But it is equivalent to five people dying of starvation in Edinburgh each year. I've no doubt that five people each year do die of starvation in Edinburgh and I think it is appalling that they should. But it is as nothing compared to what could happen, even in Britain, during the next thirty to forty years; and last year, in his masterly Masters Memorial Lecture to the Royal Horticultural Society of London, my friend, William Stearn, gave the reason. By the year 2000 the population of Great Britain may consist of about sixty millions; that, in spite of the fact that our food producing land is being rapidly and extensively sterilized for housing, factories, communications, etc., a 40 per cent increase in home food production is considered to be possible. Therefore, by the turn of the century, as far as our own resources are concerned, if fifty millions of our people are to be adequately fed, ten millions are likely to starve. *This* in under forty years, mark you, in a society enjoying a higher standard of living and an abundance of leisure previously unknown, previously undreamed of.

But consider the position elsewhere; consider the position in the developing areas south of the Mediterranean line, approximately, in the largely peasant world in Africa, Asia, and Latin America. We all know that in 1963 F.A.O. [Food and Agricultural Organization, the agency of the United Nations that institutes and administers programs, especially in underdeveloped countries, for improving farming methods and increasing food prduction] published its Third World Food Survey and concluded that, while the world food consumption level had improved over the last decade, up to half the world's population was still inadequately fed. Most of the improvement had occurred in the developed areas; the improvement in the less developed or developing areas wasn't enough to regain the unsatisfactory pre-war level. Since 1963 the position has deteriorated; in the developing regions food production lags away behind population growth to the extent that F.A.O. estimates that, in the developing areas, food supplies for the population expected must needs be increased fourfold by the year 2000, if a reasonable level of nutrition is to be provided.

It is as well to remind ourselves that F.A.O. is twenty-one years old this year [1966]. In Quebec, in 1945, it was established with forty-two founder nations. In 1965 membership consisted of 107 member nations and three associate members. F.A.O. may have had, and still does have, its critics. But F.A.O. has made the world aware of the unprecedented rate of population growth and lagging food supply and of the grave peril that this trend, if unchecked, implies for the future peace and security of the world. One aspect of this awareness has been the Freedom from Hunger Campaign which F.A.O. launched in 1960 — and the world's response to this; and, under the stimulus of the Freedom from Hunger Campaign, the World Food Programme, which moved into operation in 1963. In that year, at the World Food Congress in Washington, the importance was stressed of horticultural crops, especially legumes, fruits, and vegetables, for the improvement of food production, particularly in the developing countries. But increasing production from such crops, as with *any* crop, depends upon the introduction of new techniques; the introduction of new cultivars; the building up of increased resistance to disease and to adverse climatic conditions; improved pest and disease control techniques; improved culture, with better irrigation and increased use of fertilizers. In fact, increasing the production of any crop in the developing countries demands a full coordinated programme of research such as has been undertaken in the developed countries over several decades.

"Challenges and opportunities," says the [International Horticultural Congress] President. In vast measure they lie in the developing countries of the tropics and subtropics and there, I believe, they will have to be faced. And it is in these parts of the world where, in the future, will be made the spectacular developments in horticultural, agricultural and botanical science. Or, if the developments are made in the temperate regions, then the *application* of them will have to be in the tropics and subtropics. The challenges and the opportunities are enormous.

The area is vast; the flora of extraordinary wealth; the environments of exceeding diversity. Economically it is a great potential source of raw material. Its scientific problems are innumerable and hardly represented in the temperate regions — and are calling for urgent solution; problems horticultural, agricultural, sylvicultural, botanical; problems of plant introduction; problems of land use. It is an area in which deforestation and erosion are rapidly turning wooded mountains and grassy plains into worthless wastelands; an area in which the destruction of natural plant communities due to growing population pressure is occurring with increased rapidity; an area of wholesale ignorance concerning the most elementary conservation techniques; an area in which precious germ plasm providing possibilities for new combinations of plant materials is being destroyed; an area in which the flora and the ecology is very inadequately known — and a good knowledge of the flora and the ecology is basic to the development of rational land use, and on such knowledge a satisfactory level of living for the increasing population *must* be based.

Quite clearly, a great trained manpower is necessary to conduct essential researches in this vast and complex area — and at present this manpower is not available. There is a great dearth of students trained to undertake research in tropical biology and this state of affairs must be corrected — and a start made on the correcting *immediately*. Students — and teachers—everywhere, but especially those teaching and training in temperate countries, must be made to realise how depauperate and abnormal are the floras of temperate regions, compared to those of the tropics, and how limited is the knowledge of plant science of those trained only in such regions; they must be made to realise how enthralling are tropical floras and how immense in scope are the problems awaiting

study in the tropics – problems economic, taxonomic, floristic, ecologic, morphologic, physiologic, cytogenetic. Students in the temperate regions must somehow or other be stimulated to desire above all else to work in the tropics and it is gratifying to know that such stimulation already is at work. One knows of course that it has been at work in America for some considerable time; and likewise in the Netherlands, where the Royal Tropical Institute at Amsterdam has been functioning since 1910. But in Britain, too, stimulation has begun. This year [1966] there has been established a new Chair of Tropical Botany in the University of Cambridge. The University of Aberdeen has entered into an especial relationship with the University of Malaya at Kuala Lumpur whereby it is proposed that there should be a seconding of staff between departments in the two Faculties of Science and that an Institute of S.E. Asian Botany be established in Aberdeen University. Already the staff of the Department of Botany in Aberdeen University has been strengthened by extra appointments so that staff members may visit Malaya to undertake researches there. No doubt similar stimulation for work in the tropics and subtropics is being given to students elsewhere in Europe.

Stimulation is not enough, however. Once these students have been stimulated to work in the tropics the money and facilities for so working must be available to them. Thus governments must provide the money essential for the training of such students; governments must provide the money to strengthen the facilities at those institutions where instruction and research in tropical biology can *even now* be undertaken, as well as to build new institutions at strategic points: new herbaria, libraries, and laboratories; even new *floating* laboratories on the seas for research on the productivity of the oceans which cover 72 per cent of the globe but yield only 1 per cent of food. Governments must be made to realise that they must spend vast sums of money on projects other than military, if they are to ensure the future peace and security of the world. Governments must be made to realise that the political system which will win most lasting honour will not be the one to put the biggest satellite into orbit for the longest period of time, nor the one which is first to the moon, but rather the one which provides the greatest increase in human welfare and saves the world from famine, revolution, and war. As Sir John Boyd Orr said, nearly twenty years ago, "A civilization which cannot find food for its people is one which cannot endure." Governments must be persuaded that their priorities on these matters are quite wrong. For instance, as a result of the Freedom from Hunger Campaign, in 1964, twenty-five important horticultural projects were launched in some twenty-two developing countries, projects varying in time from six months to five years, at a total cost of about $4,150,000. I wonder, on the other hand, what it must cost to put a space capsule into orbit? Doesn't Project Apollo alone cost a thousand million dollars a year? Of course, a space capsule gives a quick, spectacular, and prestige-making return for money – sometimes; and this is what the politicians want; this is what they appreciate – anything which can be built to a given specification in a given time, to bring immediate and immense prestige.

The politicians cannot appreciate (but somehow or other they must be *made* to appreciate) the need for putting money into a time-consuming, costly, and rather uncertain undertaking such as the breeding of a new plant which could save humanity from starvation. The politicians cannot appreciate (but they must be *made* to appreciate) just what is involved, for instance, in the raising and the testing of a new cultivar. Do they realise that some four million potato seedlings are raised every year and that they must be tested for yield, disease resistance, and many another thing?; that at the Scottish Plant Breeding Station alone, some 35,000 potato seedlings resulting from controlled pollination designed to bring together desirable characters are grown each year?; that testing and selection over five years reduces this number to 300 of promise?; that it may be at least ten years from the raising of the seeds before there is the making of a crop? I am quite sure that they *don't* realize these things, otherwise it is inconceivable that they should be so comparatively meagre with their grants to the plant sciences.

And that the politicians don't realise these things is not entirely their fault. Let us be quite honest. It is in large measure the fault of the scientists themselves who have failed to give to their work the necessary wide publicity and thus who have failed to give to plant science itself the bright clear image it merits.

For instance, how many of us working in Europe know anything at all of the Conference on Tropical Botany held in the Fairchild Tropical Garden in 1960, sponsored by the National Academy of Sciences, and given financial support from the National Science Foundation, Washington? How many of us working in Europe know anything at all of the Neotropical Botany Conference held in the Imperial College of Tropical Agriculture, Trinidad, in June 1962 – again financed by the National Science Foundation – not overgenerously so, it is true, but to the tune of $9,600? How many of us working in Europe have read the reports of these two most important Conferences? How many libraries, in Europe for instance, even carry copies of these reports? How many of us working in Europe know of the new Association for Tropical Biology which was constituted at the Trinidad Conference? If far too few of us know anything about these matters we are not entirely to blame, for these immensely important projects have received precious little publicity and are therefore not nearly widely enough known even to plant scientists, let alone to the politicians. You see, we cannot entirely blame the politicians. If they are not told in simple, forceful, straightforward language just what our problems are, we cannot expect them to come rushing to our aid with large sums of money.

Unfortunately, with one or two exceptions, most horticulturists and other workers in the plant sciences are not good publicity men. It follows, therefore, that someone else must do the publicity for us and it seems to me that every research establishment could with profit use the services of a dynamic publicist to inform the world, and especially the politicians and the economists, in a spectacular fashion, of the importance of the work of the plant sciences and especially of the work of the plant breeders, who, today, so it seems to me, are the workers who have been given the greatest wisdom with the least possible facility for imparting it to others. At any rate they have the wisdom to be aware of the desperately precarious basis of the present day affluence of most of the so-called developed countries but seem sublimely content to keep this awareness to themselves instead of trumpeting it loudly throughout the world.

For instance, it really is not enough for a *plant breeder* to write in *Euphytica* that it is not generally realised on what a narrow genetical basis many of our well-known crops are founded; it is not enough for *plant breeders* to know that a mere handful of parent wheat lines have contributed to the gene content of all the Australian wheats; not enough for *plant breeders* to know that a very substantial percentage of the intermediate wheat grass acreage in the United States is planted with strains that trace to a single introduction; not enough for *plant breeders* to know that the entire acreage of the grass *Digitaria decumbens* in Central America and the West Indies originated from a single clone introduced in 1940, and that already it is necessary to spray pastures of this grass in Central America as a protection against aphids and fungal diseases; not enough for *plant breeders* to know that, of the three crops—potato, banana, sugar cane — none is represented in cultivation by more than a few hundred genotypes which are often interrelated; not enough for *plant breeders* to know that the great majority of the trees of the *Coffea arabica crop* in South America are

Wheat harvesting at Eumungerie, New South Wales. (Australian News and Information Bureau photograph by J. Tanner.)

"*. . . it is not enough for* plant breeders *to know that a mere handful of parent wheat lines have contributed to the gene content of all the Australian wheats;. . . not enough for* plant breeders *to know that the great majority of the trees of the* Coffea arabica *crop in South America are derived from a few seedlings produced from a single mother tree in the Amsterdam Botanic Garden early in the 18th century.* None *of this is enough.*"

Coffee trees growing under tall shade trees that filter the tropic sun and keep the air around the coffee trees uniformly warm and moist. (Photograph courtesy of National Federation of Coffee Growers of Colombia.)

derived from a few seedlings produced from a single mother tree in the Amsterdam Botanic Garden early in the 18th century. *None* of this is enough. It simply is not good enough for plant breeders to have this knowledge without telling the world of its true significance. Politicians and economists must be made aware, and the general public must be made aware, that the coffee industry in Ceylon was built up in exactly the same way as the South American; that in 1860 a leaf-rust disease completely wiped it out; that, if the same fungus were to be introduced into South America, *its* coffee industry could well be destroyed – and with disastrous consequences. Everybody, and especially those who hold the purse strings, must be told, for instance, that coffee rust in East African plantations commonly causes a harvest loss of 30 per cent and that it has been estimated that the chemical protection of the total East African crop would be in the region of thirty million dollars. Everybody must be told, that, in the United States alone, the cost of crop losses due to disease, in the period 1951-1960, has been estimated to be more than $3,250 million – all this mainly because crops are too narrowly based genetically to carry adequate resistance; that, lacking the genetic variability of more broadly based crops, and of natural populations, the narrowly based crop is particularly susceptible to pathogen attack.

Let us be absolutely honest in letting it be known to the politicians and economists that all this is mostly the fault of the *plant breeders* themselves; let it be known that the most permanent achievement of modern plant breeding, with the enormous genetic potential available and with all the equipment of genetics at its disposal, has been the loss or destruction of much of the world's resources of genetic variability. But at the same time let it be made known to all that a new philosophy of plant breeding is being preached which, when more universally known, and preached in a loud enough voice, *must* have an enormous influence on the future of the world; let the contents of Erna Bennett's magnificent essay, "Genecological Aspects of an Urgent World Problem," in the Scottish Plant Breeding Station Record for 1965, be made known to all. Let it be known that plant breeders are no longer dominated by the "Pure Line" concept of Johannsen which seeks to eliminate, rather than to conserve, variability in crops. Plant breeders now realise full well, for instance, that the establishment of resistance to bacterial blight in American Upland cottons can be traced to cross contamination between Upland and *punctatum* cottons in the breeding plots of pioneer cotton workers in India and in Africa, and that, had these workers maintained the standards of purity in their stocks which so many plant breeders have been requiring, the establishment of resistant Upland cottons would have been postponed indefinitely. Plant breeders are now sorely troubled by the knowledge that too many of our crops are fearfully lacking in the genetic variability which is of such importance in plant breeding work as well as in genetic studies; sorely troubled by the fact that in the gene centres of the world – which are the richest sources of genetic variability we possess—gene erosion is a present and a very great hazard and that many local races are becoming more and more difficult to find even within the gene centres. And plant breeders know full well that the preservation of these gene centres is an urgent problem of worldwide dimensions depending upon nothing less than international cooperation for its solution.

It is now [1966] five years since these vitally important matters were discussed at an F.A.O. meeting in Rome, where a number of recommendations were made which, once again, have not been given the wide publicity they deserve. There was the recommendation for the enlargement of the F.A.O. world catalogue of genetic stocks; the recommendation for the creation of areas of natural conservation within the centres of genetic diversity where plant communities may be maintained entire and *in situ;* the recommendation for the establishment of International Crop Research Stations within the gene centres with the task of fully exploring the genetic potential of these centres – stations such as the International Institute at Izmir in Turkey for the study of the Mediterranean and Near East gene centres; the recommendation for the need for far more research into the origin, genecology, adaptability, variability and distribution of plants of economic importance, because the lack or inadequacy of such research is a serious hindrance to the development of practical work in the study of the utilization of the world's genetic resources; the recommendation for the need for more trained scientists specializing in genetic conservation and plant introduction, and the need for more training institutions.

Very clearly, the full implementation of such recommendations requires a major worldwide cooperative effort; it requires the full support of governments and scientists of every country. It is as well to remember that many of the high peaks of scientific achievement have been reached through international collaboration; as well to remember that the International Geophysical Year, the International Polar Years, the Years of the Quiet Sun, and the International Hydrological Decade have provided a tremendous stimulus to scientific work.

That the stimulus to implement F.A.O.'s recommendations will be forthcoming, I have the faith not to doubt. The stimulus could well come not only through F.A.O. but also through the International Biological Programme, working under the International Council of Scientific Unions, and with its terms of reference—"the biological basis of productivity and human welfare" – a programme properly starting about 1967 and lasting for five years. And, from what I have seen and heard during this International Horticultural Congress, *I* do not doubt, and I trust that *no one* doubts, that an important role in laying the foundations of a more universally contented, well nourished human society will be played by the International Society for Horticultural Science. ■

Flower Structure and Breeding Systems

in the MAPLES

By Benedict A. Hall

In the maples, loss of flower parts and modifications of their time of functioning have resulted in the evolution of intricate flowering rhythms that favor outbreeding as against inbreeding.

Polymorphism is a common phenomenon in the living world. The gray and red phases of the screech owl are a well-known example; numerous other animal species include two or more color phases. The two sexes in our own species represent a kind of polymorphism. Polymorphism involves two or more distinct types of individuals within a given species; in some cases the relative numbers of the different forms are kept constant, one form being unable to crowd out the others through natural selection. The genetical mechanisms through which the different forms perpetuate themselves are complex and interesting.

But that is not the burden of this essay. I want to tell how polymorphism is of importance among the flowering plants, especially the maples (Aceraceae), by favoring outbreeding as against inbreeding. In order to understand the complex conditions found among the maples, it will be helpful first to consider some simpler examples in other plants.

Outbreeding is, by and large, more advantageous to a living species than inbreeding. Inbreeding brings about the union of eggs and sperms of the same genetic composition, since a single plant – or two plants more-or-less identical genetically – furnishes both egg and sperm. Outbreeding, on the other hand, involves sexual union between individuals with different genetical endowments. Hence outbreeding gives rise to new genetical combinations, whereas inbreeding maintains a relatively fixed, single combination of genetical potentialities. So long as the fixed genotype of the inbred species is well suited to the plant's environment, all is well. But when the environment changes, other genotypes, one or more of which might be well adapted

The same sugar maple, *Acer saccharum,* in winter (below) and in full summer foliage (right). (Gottscho-Schleisner)

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to the new conditions, are not available. Inbreeding, then, is a sort of genetical "putting of all the eggs into the same basket," which is not a good idea when living conditions are changing, as they usually are.

These facts account for the numerous adaptations that have arisen among flowering plants, serving to bring about cross-pollination instead of self-pollination. Such adaptations involve structural and functional modifications that favor outbreeding as well as intricate mutual adaptations between flowers and the insects or other animals that pollinate them.

Floral Breeding Mechanisms

"Heterostyly" is the term applied to one of these types of floral breeding mechanisms. Nearly a century ago Charles Darwin studied this phenomenon, and published his findings in a book, *The Different Forms of Flowers on Plants of the Same Species*, that still occupies an important place in the literature of the subject.

One of the polymorphic plants that Darwin studied was the cowslip, *Primula veris*. The two most common flower forms in this species differ in the relative lengths of the style (the pollen-receiving organ of the flower) and the stamens (the pollen-producing organs). In one flower form, called "thrum" by English gardeners, the style is short while the stamens are long (Figure 1). The other form, called "pin," is long-styled with short stamens. The transfer of pollen from one plant to another is favored by the mechanical effect of the different style and stamen lengths, pollen from long stamens tending to be deposited by insects on long styles and *vice versa*. Cross-pollination is also favored by the fact that thrum pollen is relatively sterile on thrum styles, as is also pin pollen on pin styles, whereas thrum pollen is fertile on pin styles and pin pollen on thrum styles. Figure 1 shows these "legitimate" and "illegitimate" crosses, as Darwin called them.

This condition in *Primula* is more complex than ordinary sexual dimorphism, since the flowers of each plant are both male and female, functionally as well as structurally. Yet it favors outbreeding over inbreeding, since the fertilization of a given seed results from the transfer of pollen between two different plants. (There may be some inbreeding, however, since the illegitimate unions are not entirely sterile.)

In the purple loosestrife, *Lythrum salicaria*, Darwin found a more complex kind of heterostyly, involving three flower forms instead of two. This is called "tristyly," as contrasted with the "distyly" of *Primula*. *Lythrum* has flowers of three style-lengths. Short-styled flowers have medium and long stamens, medium-styled flowers have short and long stamens, and long-styled flowers have medium and short stamens. Hence the pollination relationships are the same in principle as those of *Primula*, except that they are more complex. Figure 2 shows the three flower forms of *Lythrum*, and the legitimate pollinations. The common pickerel weed, *Pontederia*, is tristylous, like *Lythrum*. I camped along an Adirondack river during the summer in which I first read Darwin's *Forms of Flowers*. Pickerel weed was in flower along the shores of this stream. One day I collected samples of this plant from each of three different patches. To my surprise and delight I found, when I came to examine them with a hand lens, that the three samples represented, respectively, all three flower forms.

Two other mechanisms favor outbreeding. "Dichogamy" involves flowers that are bisexual (or "perfect"), having both stamens and pistil. But the stamens and pistil do not mature at the same time.

(Diagrammatic: these figures do not attempt to show accurately the actual forms of stamens and pistils, nor their relations to sepals and petals of the flower.)

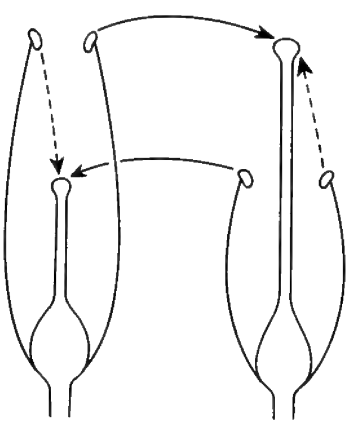


Figure 1. Heterostyly (distyly) in *Primula*. Short-styled flower (left) with long stamens; long-styled (right) with short stamens. Solid arrows indicate "legitimate" crosses, broken-line arrows "illegitimate" crosses.

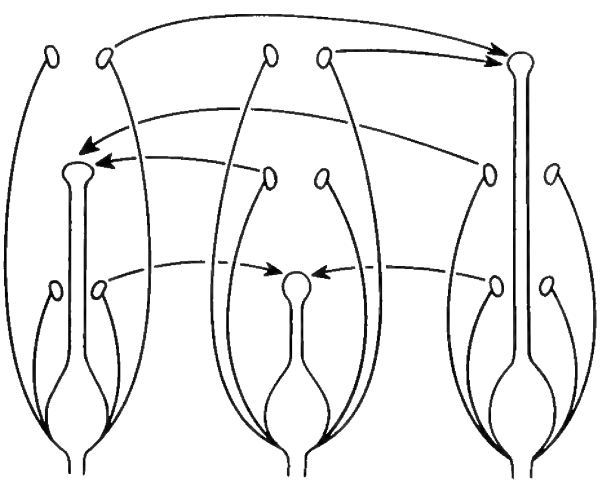


Figure 2. Heterostyly (tristyly) in *Lythrum* showing the relationships between the three lengths of stamens and styles. The arrows indicate the six possible "legitimate" crosses.

Thus, on a "protandrous" plant, the stamens shed pollen at a time when the stigma has not yet become receptive, while on a "protogynous" plant the pistil matures first. This prevents self-pollination, both between male and female parts of the same flower and between different flowers on the same plant. Consequently, although each flower functions as both male and female parent, it does not do both at the same time; and self-pollination is prevented.

The other mechanism is that of 'dioecism." Flowers that are potentially bisexual become unisexual by the failure of either the stamens or the pistil to mature. This gives rise to "monoecious" species, having separate male and female flowers on each plant; and to "dioecious" species, having the male and female flowers on separate individuals. In some species the non-functional parts of one sex are entirely lost in flowers of the other sex; in other cases, the non-functional parts persist as much reduced, abortive structures.

Breeding Mechanisms in the Maples

The maples are an excellent plant group in which to study outbreeding mechanisms. Within the single genus *Acer*, comprising less than 150 species in the world, there is a striking diversity of floral forms. Differences can be found between two maple species that are greater than the differences separating two families, as, for example, the Liliaceae and Amaryllidaceae. It is not difficult to see how these various flower types could have evolved. The course of evolution of maple flowers probably went like this:

The ancestral maple flower was bisexual, having ten stamens and a pistil made up of five carpels. During evolutionary history the numbers of flower parts of each kind (sepals, petals, stamens, and carpels) were progressively reduced. Thus a present-day species, Norway maple *(Acer platanoides)*, usually has eight stamens and a pistil made up of two carpels, in addition to full sets of sepals and petals. That the ancestral carpel number was five is shown by the fact that an occasional flower, in several maple species, has three or four, or rarely five, carpels (less frequently, I have found one-carpel pistils). In the box elder, *Acer negundo*, the flowers are much more reduced. This species is strictly dioecious. The male flowers have four or five sepals, no petals, four or five stamens, and no pistil; while the female flowers have four or five sepals and a pistil of two carpels – no petals or stamens. The fact that the flowers were ancestrally perfect is suggested by three unusual box elder trees that I found, some of whose female flowers had one, two, or three abortive stamens; and I have read of male flowers of this species with an abortive pistil, although I have never found one. Box elder, then, has evolved to a stage where inbreeding is impossible.

Flowers of the Norway maple, *Acer platanoides*. (Walter Singer)

In the Norway maple the situation is quite different. Inbreeding is still possible, although outbreeding is favored in a remarkable way. The method involves something similar to dichogamy, in that flowers become unisexual through the failure of the stamens or pistil to mature and function. A difference is that in this species the parts of one sex, in a particular flower, are not merely delayed in their development, but fail to function at all. As in dichogamy, time also becomes a factor, the result being an unusual type of flowering rhythm.

Flowering Rhythms

On April 27, flowers on the Norway maple tree in front of my residence had begun to bloom. The male flowers were opened, with stamens fully grown and just about ready to shed their pollen. Each male flower contained an extremely small, yellow-green pistil. Other flowers in each inflorescence were still closed, the petals and sepals folded over and hiding the sexual parts. These were the female flowers, which would not be ready for pollination for several days. Hidden by the closed perianth of each female flower was a pistil, reddish in color, much larger than that in a male flower.

A few days later the male flowers were wilted, having shed their pollen, and were falling off the tree. The female flowers were now fully opened. Their stigmas were enlarged, ready to receive pollen. Each female flower contained a set of quite normal stamens; but these had not opened to shed their pollen, nor did they do so later. This tree, then, was functioning first as male, later as female. In any individual flower the stamens or pistil functioned, but not both. And on a given flower cluster,

the first flowers to open were male, while the female flowers were not ready to function until several days later. Thus there was little chance for self-pollination to occur between flowers on this tree.

Other nearby trees of the same species manifested a flowering rhythm the reverse of that described above. While on some trees the male flowers functioned first, on other trees the female flowers were the first to mature, to be followed a few days later by the male flowers. Although self-pollination by either tree was prevented, cross-pollination between a male-first tree and a female-first tree was possible.

Positions of Flowers on Inflorescences

The positions of the male and female flowers on the inflorescences are significant. The first flower to mature is the one that is terminal on the main axis of the cluster. The next flowers to mature are those terminal on the primary branches. Then the flowers on secondary branches bloom, followed by those on tertiary branches, and so on. Thus there are several "flushes" of flowering, corresponding with the orders of branching. The inflorescence diagrammed in Figure 3 shows this relationship of sex of flowers to branching order. In this case the flower terminal on the main axis is female. All but two of the flowers of the second flush are also female. Nearly half of the flowers of the third flush are male. Those of the remaining two flushes are all male. In this inflorescence, then, self-pollination would be possible during the third flush, but not in any of the other flushes (except to a minor degree in the second).

One might expect that, in a male-first tree, the sexes might be distributed in the same way on the inflorescence, but with a reversed sequence of maturing. This is not the case; there is the same direct relationship between time of flowering and order of branching. But now we find the first-degree branches bearing male flowers, while the higher orders bear female ones. With different trees of the species having their sexual rhythms the reverse of each other, it is easy to see how cross-pollination would be favored and self-pollination kept at a minimum.

Evolutionary Trends

The sugar maple, *Acer saccharum*, has essentially the same sort of flowering rhythm as the Norway maple. A male-first inflorescence is diagrammed in Figure 4, a female-first in Figure 5. The sugar maple is more advanced, evolutionarily, than the Norway maple. Besides the reduction in the essential parts, stamens and pistil, there has been a loss of the petals. The nectar-secreting disk is much

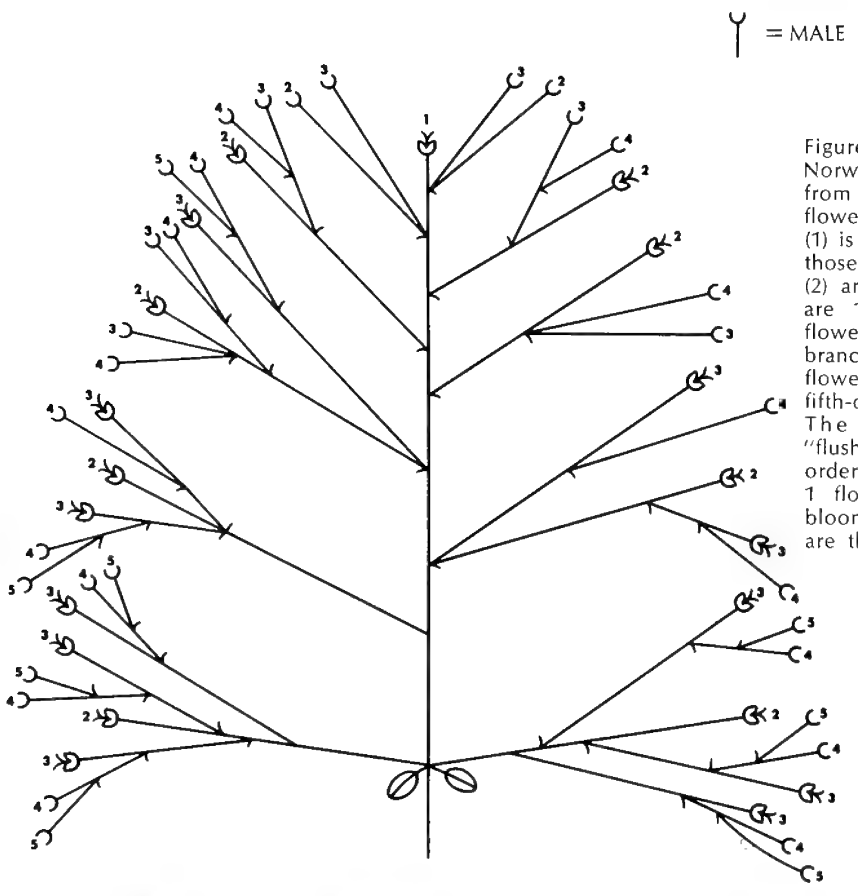


Figure 3. Diagram of an actual Norway maple influorescence from a female-first tree. The flower on the first-order branch (1) is functionally female; 8 of those on secondary branches (2) are female, 2 male. There are 11 female and 7 male flowers on the third-order branches (3), while all the flowers on the fourth- and fifth-order branches are male. The order of flowering "flushes" corresponds with the orders of branching, the No. 1 flower being the first to bloom, while the No. 5 flowers are the last to bloom.

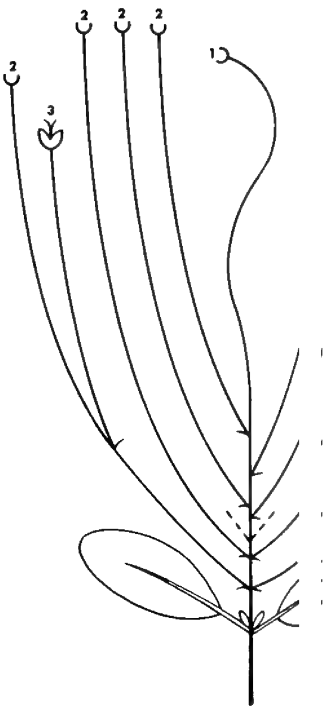


Figure 4. Diagram of a male-first inflorescence of sugar maple. All the No. 1 and No. 2 flowers are male, the two No. 3 flowers female.

reduced in sugar maple. The massive disk of Norway maple is undoubtedly an adaptation favoring insect pollination; while in sugar maple the absence of petals and the long, flexible stalks from which the flowers hang downward would seem to favor wind pollination.

Norway maple is monoecious, the functionally male and female flowers being borne on the same tree. A step toward dioecism is found in the red maple, *Acer rubrum,* and in the silver maple, *Acer saccharinum.* In these species, the flowers on a given tree all become functional within a day or two, so that there is no sexual rhythm like that of Norway maple or sugar maple. Most of the trees have only male or female flowers, not both; but occasional trees have flowers of both sexes. Therefore, these species are predominantly dioecious, but they retain a minor degree of monoecism. We thus see in the series – Norway maple, red/silver maple, box elder – an evolutionary trend from monoecism, with flowers structurally though not functionally bisexual, to partial dioecism, to strict dioecism, with the flowers structurally as well as functionally unisexual. This does not mean that red maple, for example, has evolved from Norway maple, or box elder from red maple. What it does mean is that red maple probably evolved from ancestors whose flowers had the same degree of reduction as those of Norway maple, and that at one stage of their evolutionary history, the ancestors of box elder had flowers much like those of red maple today. The present-day species mentioned have not all advanced equally far along this evolutionary path.

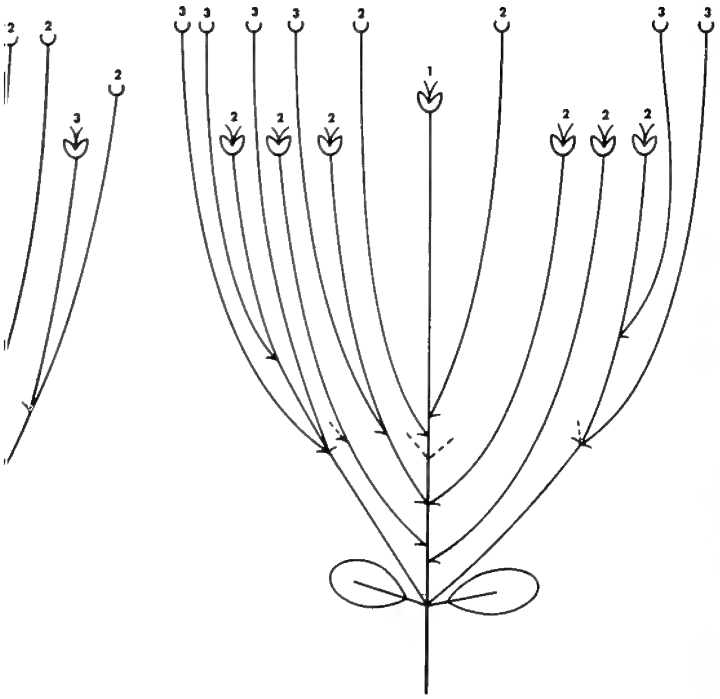


Figure 5. Diagram of female-first sugar maple inflorescence. The No. 1 flower and 6 of the No. 2 flowers are female. Two of the No. 2, and all of the No. 3 flowers are male.

The flowering rhythm manifested by Norway maple complicates this evolutionary sequence. Norway maple is in one sense monoecious, having both functionally male and female flowers on each individual tree; but when time is considered, a tree functions in a given period as male or female, not both (except in the flush of overlap, as the No. 3 flowers in Figure 3), and to that extent it is functionally dioecious. Thus, the species is able to benefit from the advantages of both monoecism and dioecism: while obtaining the benefit of dioecism in encouraging outbreeding, it yet retains the advantage of monoecism, in that every tree of the species produces seeds.

Unanswered Questions

Much work remains to be done on these breeding mechanisms of the maples. In the Norway maple, the stamens in a functionally female flower develop in an apparently normal way, but not to the point of shedding pollen. The pollen grains appear to be viable, but the anther fails to dehisce (burst open) and release them. Are these pollen grains actually capable of functioning? It might be possible to answer this question by removing pollen grains from the anther at their most mature stage, then seeing whether or not they are capable of producing pollen tubes, either on a culture medium or on the stigma of a female flower. If they are, then it would appear that the female flower is made unisexual only by the failure of the anthers to dehisce. In that case, an investigation of the mechanism of anther dehiscence, and its causes, would be in order.

Another question to be answered is that of the possibility of self-pollination during the middle flushes of flowering (the No. 3 flowers in Figure 3). Self-pollination would seem to be possible during those flushes – *if* the pollen grains are capable of growing into pollen tubes on the stigmas of other flowers on the same tree. The experimental transfer of pollen from these anthers to the appropriate stigmas would answer this question. If the pollen were in this case found to be incompatible, the question of the mechanism of incompatability would remain. A similar study could be made of the failure of the pistil to mature in a functionally male flower.

Thus, as happens in all branches of science, the answering of one question brings forth further questions to be answered. As a matter of fact, the value of a scientific discovery can be measured by its effectiveness in engendering new questions. This places every scientific idea in an historical framework, since it grows out of past discoveries and leads to future ones. As one biologist has said, biology *is* its history. ■

Conservation and the Preservation of Species

By William C. Steere

Director, The New York Botanical Garden

The preservation of the world's resources of living organisms in terms both of their esthetic and practical values will come about only when man decides to give up his age-old practice of ruthless exploitation of anything that will yield a profit now, without regard to its unfortunate effects on future generations. When I see the injunction, "Travel now, pay later," so common today, my mind turns at once to our exploitative treatment of our natural resources and our natural environment. Unlike the cost of travel, which is predictable, the cost of "pay later" for unsound and unwise attitudes vis-à-vis conservation today will put an astronomically high tax on generations to come.

Conservation signifies many things to many people—it is an attitude, a frame of mind or reference, an ideal; to some, even a kind of religion. Like any concept, conservation is flexible and operates at various levels. To one person it may mean the saving of one great oak or a small colony of arbutus from the site of a projected highway or shopping center. To another, it means saving our forests and other natural resources for future generations. Every day, we realize with more and more force how fundamentally the environment affects the organisms living in it, and how impracticable, if not impossible, it is to attempt to preserve rare species of plants or animals in the wild without at the same time conserving their natural habitats. No matter how conservation-minded we may be, we must recognize that, because of broad-scale changes in environment occurring either naturally or produced by man, many species are already and predictably headed for extinction, although they will almost certainly still be found in cultivation long after the last wild population has disappeared.

Large woody gymnosperms are well known from fossil deposits 250-300 million years old and other large woody conifers—or evergreens—are well known from fossil deposits no more than 100 million years old. As one paleontologist pointed out, the first primitive trees existed some hundred millions of years before the first bird evolved to sit in them! Broad-leaved, hardwood trees, which are true flowering plants, are relative newcomers in geological time, and appeared perhaps 150 million years ago. So many kinds of conifers have become extinct and are known only as fossils that we are fortunate indeed that any members at all of this ancient group should be alive today, as they have been so very aptly called "living fossils."

While wholeheartedly espousing the important cause and waving the banner of "Save the Redwoods!" we must also consider some of the basic botanical science behind these magnificent and geologically ancient trees, as well as others of their cone-bearing relatives. For example, in any discussion of conserving the coast redwood *(Sequoia sempervirens)*, we must keep clearly in mind the fundamental difference between preserving majestic stands of living trees and the survival of the species itself, a difference that is too often lost sight of under emotional stress.

A species of animal or plant, once extinct, is gone forever—it can never be recreated, since it represents the end product of tens or hundreds of mil-

Sequoia gigantea in the Mariposa Grove, Yosemite National Park. (National Park Service Photo by Ralph H. Anderson)

Welwitschia mirabilis (male plant) in its S. W. African habitat. (Photograph by Dr. Robert J. Rodin, California State Polytechnic College)

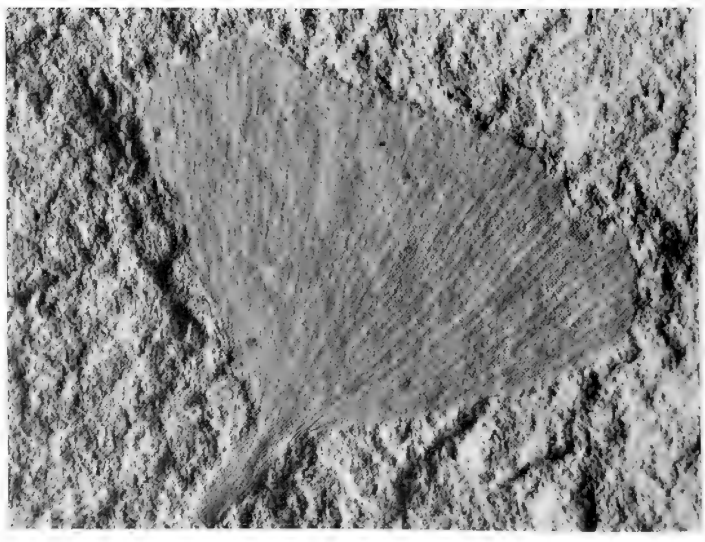
lions of years of evolution. Man has hastened the disappearance of organisms already teetering on the brink of extinction, as the dodo bird; on the other hand, to his eternal credit, he has also rescued other species from oblivion. The most significant and predictable symptom of approaching extinction for any kind of organism is its rigid dependence on some one narrow and restricted niche in its environment for its natural reproduction, as well as a limited geographical distribution. Early in their evolutionary development, these now geologically and biologically ancient species undoubtedly possessed a much greater genetic flexibility that in the first place enabled them to adapt to their present ecological niche from some other habitat. Probably by great reduction in the size of the population and the geographical range, these species have lost their genetic potential for variability and adaptability through the millenia, to such an extent that any relatively small but long-lasting change in climate could easily precipitate their extinction, simply by altering the conditions of the ecological niche to which they are so highly specialized and genetically "frozen." It is certainly no accident that the two kinds of sequoia, the coast redwood and the big tree of California, should be enormously long-lived, since these species must owe their survival today to a life span so great that any one individual can endure one or several major climatic cycles—and we well know that some of the sequoias still living have done so for the past 3,000 years. Again, we should make a fundamental biological distinction between an environment that will simply allow species to survive and an environment that will allow species to reproduce naturally.

The coast redwood, *Sequoia sempervirens,* is restricted in its distribution today to the outer Coast Range of the Pacific Coast, from central California to southernmost Oregon. Moreover, within this restricted geographic range, it occurs only in valleys exposed to fog moving in from the Pacific Ocean. From fossils, we know that, in relatively recent geological time, perhaps 50-60 million years ago, the coast redwood also inhabited the interior ranges above the central San Joaquin Valley of California when it was a great bay of the Pacific; in much earlier geological times, this species was very widely distributed over the Northern Hemisphere. The gradual drying out of habitats through geological time and the equally gradual loss of genetic flexibility by the reduction in size of the total population of the species has set the coast redwood on a collision course with its ultimate extinction, no matter how much we might wish it to survive.

Yet, within its narrow environment, the coast redwood flourishes—it reproduces well and competes successfully with the other species comprising its highly characteristic plant association. Its success within the fog belt appears to hinge on a peculiar ability of the leaves to condense fog into water, so that under a coast redwood tree we find a level of precipitation several times higher than the normal rainfall for the same area. An interesting fact about the coast redwood is that, for all practical considerations, an individual is immortal. If a

Ginkgo biloba.

Leaf impression of fossil *Ginkgo adiantoides* from the Ruby Basin in southwestern Montana, courtesy of Herman F. Becker, Curator of Paleobotany, The New York Botanical Garden. (Walter Singer)



tree is cut down or is destroyed by natural means, it promptly sprouts from the base to form a circle of a dozen or so new trees; in the same manner, a fallen trunk sends up a long line of new shoots.

The big tree of the Sierra Nevada of California, *Sequoiadendron giganteum*, had, early in its geological history, almost a world-wide distribution; today it occurs as only a few groves of trees and is one of the few species of plants in which the total number of living specimens in the wild population is known by actual count. In fact, there are probably more specimens of the big tree under cultivation than still growing wild! Because of its extraordinarily thick bark and great height, the big tree is immune to damage from forest fires; as a matter of fact, it will reproduce only after the forest floor has been cleared out by fire and sufficient light has thus been admitted. This curious situation well illustrates one of the many dilemmas inherent in ecology and conservation—whether to burn the forest and allow the development of a new generation of big trees, or whether to preserve the other trees associated with them! Fortunately, this decision is not immediately urgent as we have perhaps a thousand years in which to arrive at it.

Metasequoia glyptostroboides growing at The New York Botanical Garden.

A fascinating relative of the sequoias is *Metasequoia glyptostroboides*, the dawn redwood, which was known for a century only as a fossil plant before it was discovered in 1945 to be still living in a remote forest of southwest China. Hardier than *Sequoia*, the dawn redwood is widely planted in the eastern United States from seeds distributed by The New York Botanical Garden.

But for the intervention of man, some species of plants would have disappeared from the face of the earth. In Japan, the maidenhair tree, *Ginkgo biloba*, was saved from extinction by early priests who, impressed by its excessive rarity in the wild, transplanted it to temple gardens—it is not known today at all in the wild, yet the fossil record shows that many millions of years ago it was spread widely through the Northern Hemisphere, including Europe and North America. I have collected excellent leaf impressions of fossil *Ginkgo* far north of the Arctic Circle, along the Coville River in Alaska. It is interesting to find that in Japan today the enormous specimens of *Cryptomeria japonica*, the Japanese cedar, growing in temple grounds are considered to be holy trees. Certainly, they are far larger than any specimens to be found growing wild, yet they have probably been planted within the last thousand years.

Many other curious "living fossils" related to conifers still thrive in subtropical and tropical climates, among them the fernlike cycads and *Welwitschia mirabilis*, an extraordinary woody plant restricted to the deserts of southwest Africa. A noteworthy biological feature of all the geologically ancient conifers mentioned here is that although they can be grown relatively easily under cultivation, they do not reproduce spontaneously outside the narrow habitats in which they occur naturally. For example, *Ginkgo* is widely used as a street tree in the large cities of the eastern United States, where it resists smoke and soot damage because of its deciduous habit. Although the female trees may produce olivelike, ill-smelling fruits in great abundance, I have never seen a self-seeded plant, a general observation that applies also to *Sequoia* and *Metasequoia* under cultivation.

In conclusion, I would like to emphasize once more the difference between preserving populations of interesting or spectacular species, especially of coniferous trees, and conserving the species themselves, when they are actually living fossils marked for eventual extinction by Nature herself, through normal long-term changes in climate and environment of the earth. ■

John Posmik, gardener at the Botanical Garden, explains to a student trainee the importance of labeling plants correctly.

A Pilot Program in Gardener Training

In September 1963 The New York Botanical Garden, in collaboration with Christopher Columbus High School in the Bronx, began its participation in a Municipal Cooperative Education Program approved by the Board of Education and designed to provide high-school students with on-the-job training in gardening, landscaping, and allied fields. This program was initiated by The New York Botanical Garden as the outcome of a proposal made by a member of its Board of Managers, Mrs. Arthur Hays Sulzberger, that the Botanical Garden should explore the possibility of participating in the Municipal Cooperative Education Program and that it should accept the responsibility for providing practical on-the-job apprenticeship training in gardening for high-school students.

The special objectives of the program were to encourage and make it possible for a group of boys not expected to complete high school to continue until they were graduated and to provide opportunity for them to learn useful skills and craftsmanship as well as to earn needed money, and to develop experienced workers in a field for which there is great need of trained men—that of practical gardening. The pilot operation reported upon here was made possible by a fund obtained through the efforts of Mrs. Arthur Hays Sulzberger. Contributors to the fund were the Marion R. Ascoli Fund, Mr. and Mrs. Edward C. Delafield, The Heckscher Foundation for Children, Lehman Brothers, New York Foundation, Inc., The Overbrook Foundation, Mr. Laurance S. Rockefeller, Alfred P. Sloan Foundation, Mrs. Thomas J. Watson, and others. The fund was used only to pay the trainees; all other operational and administrative expenses of the program were assumed by The New York Botanical Garden. The pilot plan provided for thirty young men in two groups of fifteen to work alternate weeks at their studies at Christopher Columbus High School. School work was related to and coordinated with their practical training.

From the beginning the Botanical

Students make cuttings of euonymus plants.

Trainee gardeners discuss how to cut back coleus plants.

By Thomas H. Everett

Photographs by Walter Singer

Garden training was established on an eminently practical and work-a-day-world basis. Always, first consideration was given to the needs rather than to the desires of the trainees. In addition to learning how to perform the various operations of the craft expeditiously, the young men were thoroughly grounded in the importance of good work habits, and of developing satisfactory relationships with fellow employees, supervisors, and the visiting public.

This apprenticeship training, always under the supervision of experienced gardeners and foreman gardeners, was fortified by field and classroom demonstrations given under the supervision of the Education Department of The New York Botanical Garden, and by occasional visits to other horticultural establishments.

The pilot program has now been phased out and it seems appropriate to provide a statistical report of the results. Thirty trainee-gardeners were appointed in September 1963; of these, before February 1964, three left the program voluntarily and one because of illness; four replacements were made. Thirty trainee-gardeners, then, had opportunity to complete the program and achieve both high-school diplomas and New York Botanical Garden certificates; twenty-three of the thirty did so. Of the twenty-three, sixteen left to accept permanent jobs in the field of horticulture; five left to accept permanent jobs in other fields; two joined the armed services immediately after leaving the program. Of the sixteen who obtained jobs in horticulture, four received permanent appointments at The New York Botanical Garden, one joined the grounds staff at Fordham University, two joined the gardening staff of Old Westbury Gardens, one became a gardener at Lincoln Towers housing development, two secured jobs on private estates, and six obtained employment in commercial establishments. It is of interest to note that more horticultural jobs were available than could be filled by qualified trainees. Because of variations in dates of appointments and dates of completion of their work at the Botanical

Garden, the actual time spent by the twenty-three individuals who finished their training at the Garden varied from nine months (in three instances) to twenty-eight months (in four instances) with an average of twenty months.

Of the original thirty trainees, seven left the program prematurely: one because of serious illness (this trainee later returned to a fulltime high-school program and received a high-school diploma); two voluntarily (both obtained fulltime jobs not in the field of horticulture); two completed two years' work at The New York Botanical Garden but did not obtain their high-school diplomas (both obtained fulltime jobs not in the field of horticulture); two were released by Christopher Columbus High School with the concurrence of The New York Botanical Garden.

The objectives of (1) retaining in high school youths likely to drop out, and (2) training young men to become useful workers in horticulture or other fields were clearly realized in this pilot program. An especially encouraging outcome was the assurance of continuance of this training program through finances provided through the Department of Personnel of the City of New York. The program, extended and financed in this way, has been in successful operation since September 1965.

The success of the work-training program reflects a philosophy which recognizes without prejudice to formal academic education that youths not well oriented to such instruction and unable to achieve appreciable success, satisfaction, or a feeling of adequacy in the classroom are likely to respond to on-the-job training of an apprenticeship character carried out under strictly practical conditions and for which they receive fair monetary compensation. Such environment and conditions make sense to the youngsters. They understand and accept the necessary (and sometimes not too gentle) disciplines applied by mature and experienced fellow workers, foremen, and other supervisors better than they do school disciplines. They soon find that limited aptitude for academic subjects does not necessarily preclude achievement in other fields. For the first time in their lives many of the trainees savored the pleasure of accomplishment and gained the respect of men whom they respected. Of even greater importance they gained self-respect. A quite unexpected result was that the school

Miss Bride McSweeney, Foreman of Gardeners, oversees a student working in the rock garden.

John Diver, a veteran gardener at the Botanical Garden, demonstrates to a student the fine points of transplanting.

performance of many of the trainees improved markedly after their entrance into the program. Their motivation in this direction was clearly indicated by the fact that several bolstered school work by taking additional courses in horticulture offered at The New York Botanical Garden that involved evening attendance in out-of-work hours.

Everyone closely associated with this pilot program has been tremendously impressed by the great change in the attitude of the trainees. When appointed they were, as a group, markedly suspicious, resentful, uncommunicative, and to a large extent hopeless about their futures. By the time they were graduated they had confidence in their ability to cope with their environment and to take their places as productive workers and were cheerful, communicative, and well adjusted.

Especial credit is due to Miss Grace Brennan, Director of Cooperative Education of the Board of Education, who worked with great dedication and effectiveness in planning, establishing, and guiding this project. Mr. William Harris, President, M. Goldfarb-My Florist, Inc., was a source of generous encouragement and sound advice at all times. The sympathetic understanding of Mr. Edward Kolevzon, Principal, of Mrs. Margaret B. Parsons, Coordinator of Cooperative Courses, and of the teaching staff of Christopher Columbus High School, as well as the excellent school curriculum provided for the trainees, certainly ranked with the efforts of The New York Botanical Garden in assuring the success of this program. Mr. T. H. Everett, Assistant Director (Horticulture) and Senior Curator of Education, Miss Elizabeth C. Hall, Associate Curator of Education, Mr. Louis P. Politi, Horticulturist, and Gardening Department supervisors Vincent Algozino, John Borin, Marcel Candia, Frank DiGenova, Richard Livellara, Cosmo Petrone, Robert Russo, John Swan, and Miss Bride McSweeney were responsible for planning and operating the Botanical Garden's part in this program. Dr. Bernard Donovan, Superintendent of Schools, and other officials of the Board of Education at all times lent their fullest support to this experiment in high-school retention and gardener training, as did the Board of Managers and the Director of The New York Botanical Garden.

The total cost of the pilot program, over and above the expenses of administration and supervision provided by the regular staff of The New York Botanical Garden, was $33,572.39. This expense was met from the special fund raised by Mrs. Arthur Hays Sulzberger. The only disbursements from the fund were used to pay wage allowances to the trainees and their Social Security payments.

It is of interest to note that, in addition to the four trainees who were appointed as permanent gardeners at The New York Botanical Garden immediately upon being graduated from the course, two who left to take other jobs later received appointments to permanent positions at the Botanical Garden. Appointees to these positions were Thomas Hair, Joseph Keegan, Peter Maher, James Martucci, Raymond Novy, and Matthew Pozzuto. ■

MR. EVERETT, Assistant Director (Horticulture) and Senior Curator of Education, The New York Botanical Garden, wrote this report on July 17, 1967.

Classroom training as well as on-the-job experience under expert gardeners is included in the cooperative education project. Here, Godfrey Jackson, instructor in biology at Christopher Columbus High School, discusses chemical fertilizers with students.

"The legacy of The New York Botanical Garden is knowledge, and its ideal is truth and service. We do not want these values to be neglected; indeed, we should like today to commend them to the Nation."—George B. Hartzog, Jr., Director of the National Park Service, May 1, 1967.

THE NEW YORK BOTANICAL GARDEN: A Registered National Historic Landmark

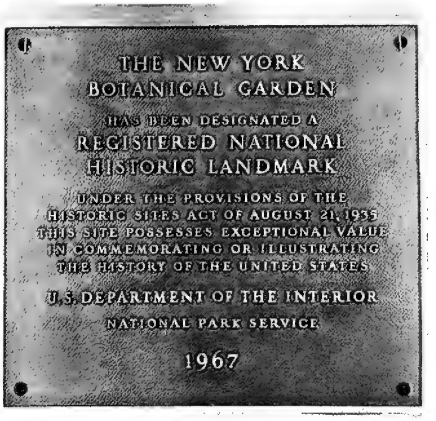
By Elaine C. Cherry

Stunningly illuminated flowers, waterfalls, and tropical foliage enchanted two hundred guests—representative leaders in government, science, business, and cultural affairs—who strolled through The New York Botanical Garden's conservatories in a prelude to a formal dinner on the evening of May 1, 1967. The occasion was a triple celebration: the 75th anniversary of the founding of The New York Botanical Garden; the announcement of the $40 million development program for the growth and expansion of the Botanical Garden during the next twenty-five years; and—highlight of the evening—the designation of The New York Botanical Garden as a Registered National Historic Landmark.

The Honorable George B. Hartzog, Jr., Director of the National Park Service, presented to the Botanical Garden a handsome certificate signed by himself and by Stewart L. Udall, Secretary of the United States Department of the Interior; and, as a permanent reminder of its status as a Registered National Historic Landmark, a bronze plaque inscribed "The New York Botanical Garden has been designated a Registered National Historic Landmark under the provisions of the Historic Sites Act of August 21, 1935. This site possesses exceptional value in commemorating or illustrating the history of the United States. U.S. Department of the Interior, National Park Service, 1967." The plaque will be installed on one of the two Corinthian columns that frame the main entrance to the Museum Building, together with another and much older plaque commemorating the foundation of The New York Botanical Garden.

Remarks of George B. Hartzog, Jr., Director of the National Park Service, at the Presentation of the Registered National Historic Landmark Plaque for The New York Botanical Garden, New York, May 1, 1967:

For over 70 years The New York Botanical Garden has been striving to discover more about our plant life and to convey its meaning to us. As a pioneer in botanical research and collection, its influence has been international. It is today recognized as one of the outstanding botanical gardens of the world. The legacy of The New York Botanical Garden is knowledge, and its ideal is truth and service. We do not want these values to be neglected; indeed, we should like today to commend them to the Nation.



Congress has given to the National Park Service the task of identifying the places of our history which have contributed importantly to the history and development of the United States. Scientific accomplishments and educational achievements are, of course, essential themes of our American heritage. Through the Registry of National Historic Landmarks, carefully selected sites are given national recognition. The tapestry of our history contains many threads. We in the National Park Service believe that history is not restricted to "birthplaces and battlefields." The National Registry contains sites which commemorate the whole sweep of our history: Walden Pond in Massachusetts and the Cable Cars of San Francisco; Virginia City, Montana, and the King Ranch in Texas; Nassau Hall at Princeton and the California ranch of Jack London.

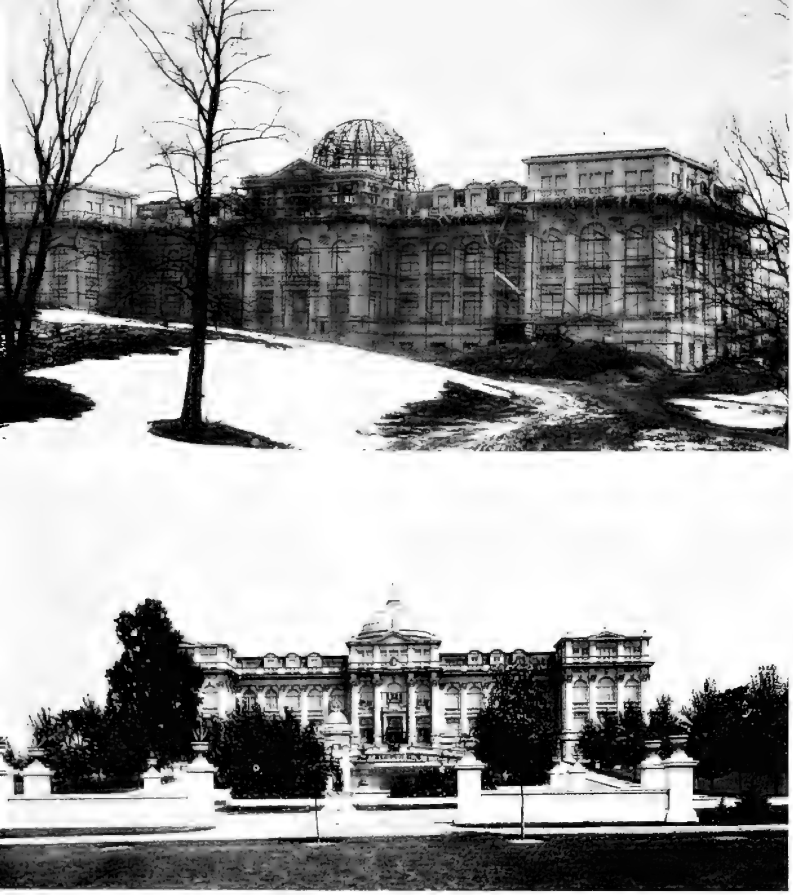
For centuries man has thought about—and written about—the importance of nature to his well-being. The inspiration and enjoyment received from association with the outdoors has never been questioned. As long as there was plentiful opportunity and

KEY TO AERIAL PHOTOGRAPH

1 Children's Garden
2. Leguminous Trees
3. Beech Grove
4. Magnolia Exhibit
5. Oak Exhibit
6. Oriental Dogwoods
7. Experimental Garden
8. Stout Daylily Hybrids
9. Hornbeam Hedge
10. Nursery
11. Lilac Collection
12. Rose Garden
13. Maple Collection
14. Montgomery Conifer Collection
15. Flowering Cherry and Dogwood Exhibit
16. Oriental and Native Dogwood Exhibits
17. Cherry Exhibit
18. Azalea Collection
19. Daffodil Exhibit
20. Native Pine Collection
21. Native Hemlock Preserve
22. Azalea, Rhododendron, and Laurel Exhibits
23. Native and Exotic Pines
24. Rock Garden
25. Native Plant Garden
26. Euonymous Exhibit
27. Pinetum
28. Herb Garden
29. Wild Flower Exhibit
30. Iris, Garden Flower, and Hedge Plantings
31. Dahlia and Garden Flower Exhibits in Season
32. Stewartia Collection
33. Azalea Varieties
34. Museum Building—Exhibits, Herbarium, Library
35. Laboratory Building
36. Conservatories
37. Waterlilies
38. Lorillard Snuff Mill
39. Lorillard Bridge
40. Bronx River Gorge
41. Bronx River Falls
42. Bronx Zoo
43. Fordham University
44. New York Central Railroad Station
45. Bronx River Parkway

)RK BOTANICAL GARDEN

A REGISTERED NATIONAL HISTORIC LANDMARK



Top, Museum Building under construction, 1899.
Bottom, Museum Building, 1906.

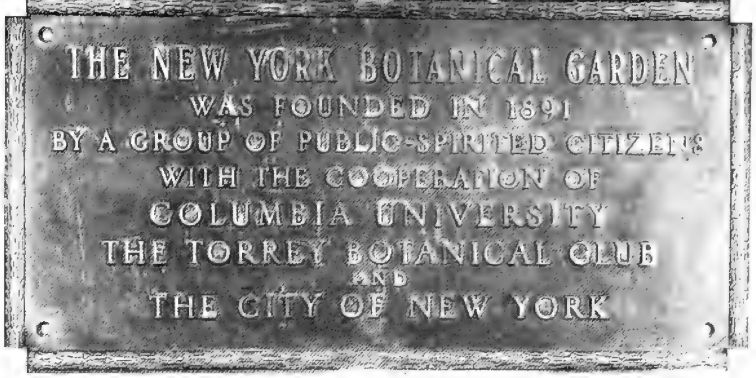
Museum Building, 1962.

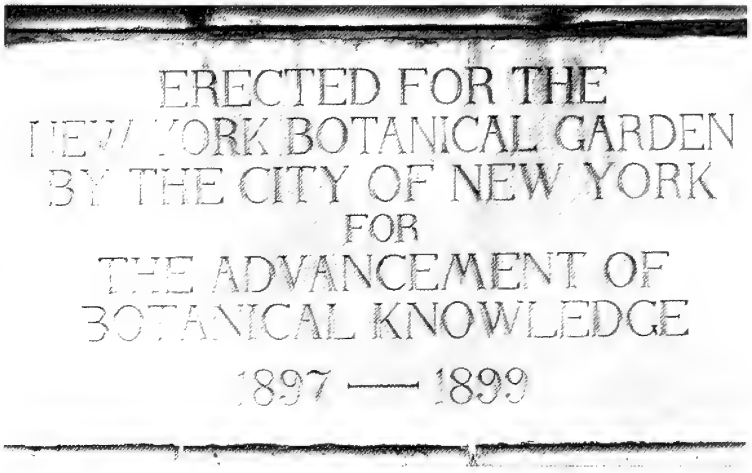
School children visit educational exhibits in the Museum Building.
Above, 1962.
Above right, 1906.

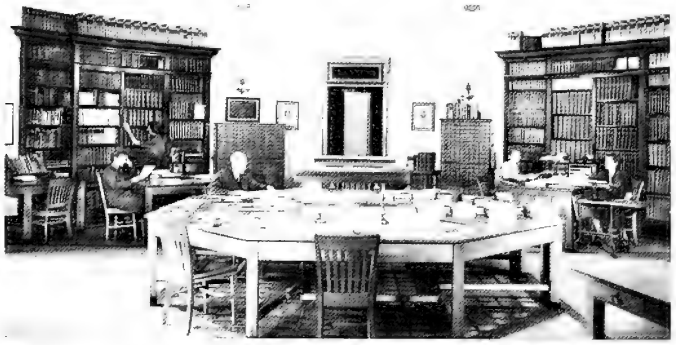
Numbers on photographs relate to numbers on the aerial photograph pages 100-101.

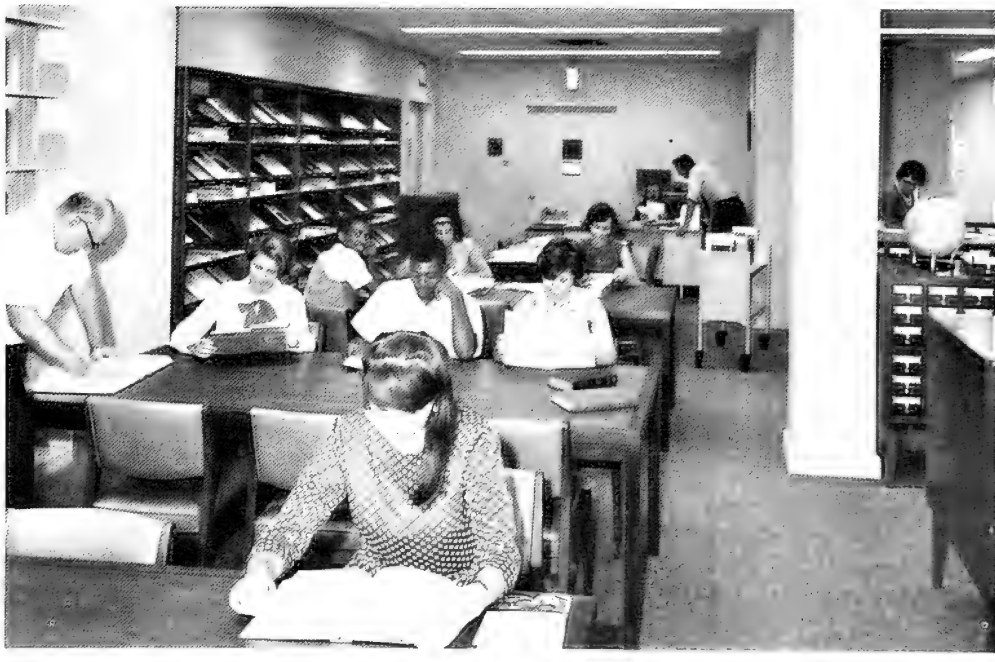
man was free to roam the land and indulge in recreational pursuits to his own satisfaction, society was concerned with nature only on the philosophical level. But when the expanding development of a growing civilization began to limit his opportunity and his freedom to satisfy his individual needs, then it became a matter of public interest and national responsibility. So it was that more than a century ago society began to concern itself with the conservation of natural landscapes and beauty for man's welfare. Out of that concern came, in 1872, Yellowstone National Park, established by a far-sighted Congress almost 20 years before the closing of America's western frontier. Now our National Park System contains some 240 parks which this year will receive more than 150,000,000 visitors.

Out of that original concern, too, came the inspiration of Professor and Mrs. Nathaniel Britton, leading to the establishment of The New York Botanical Garden in 1891. In the succeeding years of the 20th century, the programs and objectives of The



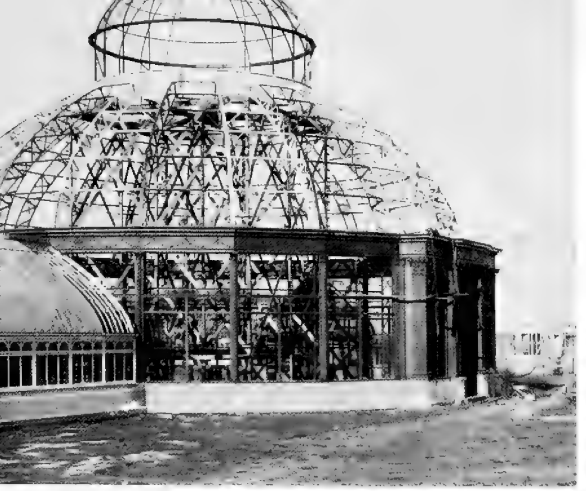






Above, Library, about 1942. This room is now the John Torrey Room. Below, Library, 1967, in the wing added to the back of the Museum Building in 1966.

New York Botanical Garden have not been dissimilar to those of the National Park Service: wide-ranging educational activities, research in the many areas of plant ecology, service to the people of this community. Since its beginning the Botanical Garden has fulfilled its stated commitment to the "instruction of the people," and certainly, to people's enjoyment and appreciation of their environment. In such current research programs as the implication to food supplies of the world population explosion, and the utilization of



fungi and algae for producing protein, The New York Botanical Garden continues its commitment to the welfare of all mankind.

All of us who are concerned with the quality of man's environment subscribe to the ancient proverb which says, "To survive, all men must join hands." Laurance S. Rockefeller, in a recent statement, summarized our position, and defined our opportunity: "To us is given the task of helping to mold the growth of the country, to us is given the task of seeing that growth brings not only a bigger but a better America; to us is given the task of insuring that leisure is a blessing, not a curse of idleness."

In this crusade to establish a new land ethic for our country, the credentials of The New York Botanical Garden are truly outstanding: the largest herbarium and botanical library in the Western Hemisphere; discoveries of importance to every American—the process for "puffing" rice; seedless grapes; antibiotics; a publication program in the field of botany unsurpassed throughout the world.

It is, therefore, a rare pleasure to designate The New York Botanical Garden as a Registered National Historic Landmark for its significant contribution to human knowledge and welfare through its programs of research, publishing, and education.

Top, framing the Palm House, November 1899

Center, the Conservatory, 1901

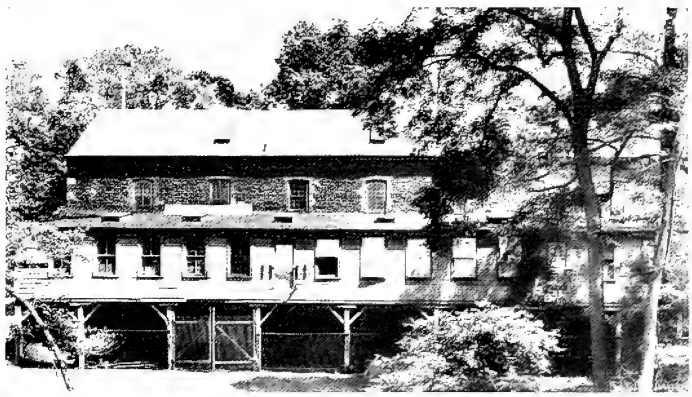
Bottom, the Conservatory, 1963

Mrs. Hermann G. Place, a Vice President of the Board of Managers of the Botanical Garden, initiated the application for registration as a National Historic Landmark, and provided the impetus to accomplish in a short time the great amount of documentation and surveying required by the National Park Service. Several other members of the Board joined forces to give strong support to the idea, once the application had been submitted. Thus, the Botanical Garden is included in the 756 Landmarks now comprising the Registry of National Landmarks, a program of public service administered by the National Park Service. It was to establish an inventory of the nationally significant historical and natural properties of America, and to vigorously encourage their continued preservation, that the Registry of National Landmarks was undertaken. The program is vol-

The late Frank MacKeever, Herbarium Specialist, examining herbarium specimens.

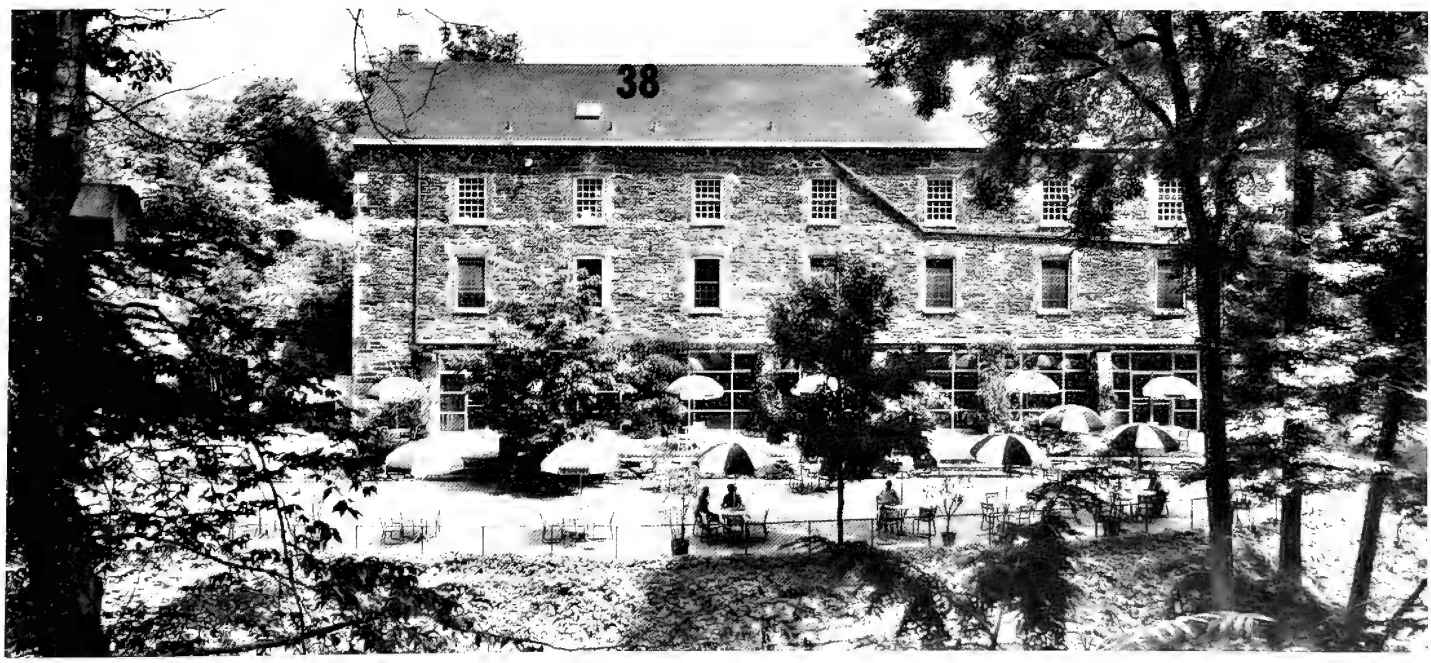
Bassett Maguire, Head Curator, checks mounted specimens in the Herbarium.

The mill of 1792.



Lorillard fieldstone mill, 1840.

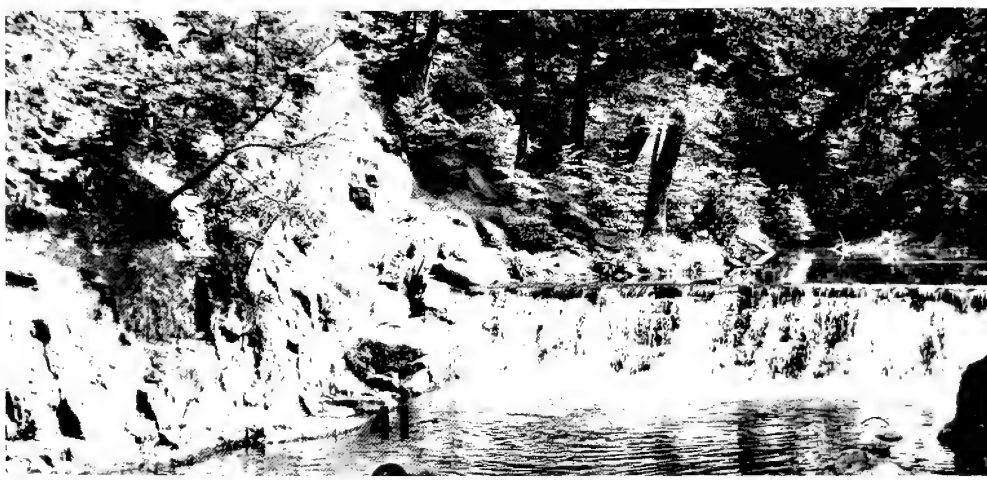
Lorillard Snuff Mill, 1967.



Cutting hay with mower and scythe in Magnolia Valley, August 1917.

Pinetum, 1910.

Nathaniel Lord Britton, Director, Thomas A. Edison, Marshall A. Howe, Assistant Director, July 1927.



Ceremony establishing The New York Botanical Garden as a Registered National Historic Landmark was recorded by CBS-TV reporter Chris Borgen who interviewed Mayor of the City of New York John V. Lindsay, Botanical Garden President Charles B. Harding, Botanical Garden Director William C. Steere, Director of the National Park Service George B. Hartzog, Jr., and August Heckscher, Commissioner of Parks for the City of New York. May 1, 1967.

The Bronx River flows through The New York Botanical Garden—all that is left of the New York the Indians knew. Wild flowers abound in the surrounding oak-hemlock-ash forest. 1963.

Bronx River Falls, 1963.

Hemlock Grove, 1911.

Bronx River Gorge, 1895.

Laboratory Building, 1966.

Photograph of an oil painting of the Elgin Botanic Garden, about 1814.

untary. Landmark designation does not change ownership of or responsibility for the property; the owners agree to maintain the integrity of the site and to manage it in a manner consistent with accepted preservation and use practices. The single, absolute requirement in the evaluation of an area proposed for designation as a National Landmark is that it be of *national significance;* each selected site must possess exceptional significance in illustrating or commemorating the natural character or the historic heritage of the United States. To possess national significance, a historic site must possess integrity; integrity requires original location and intangible elements of feeling and association.

Dr. William C. Steere, Director of The New York Botanical Garden, wrote in the June 1967 NEWSLETTER (the Botanical Garden's publication for its members):

> The New York Botanical Garden stands to some extent as the lineal descendant of the Elgin Botanical Garden, established in 1801 on the present site of Rockefeller Center by Dr. David Hosack—the first venture of its kind in New York City. When the cost of maintaining his botanical garden grew beyond his financial means, Dr. Hosack sold it to the State of New York, which in turn granted it to Columbia University in 1814. It is not entirely coincidental, then, that a professor of botany at Columbia University, Dr. Nathaniel Lord Britton, should have had the inspired idea, in 1888, of establishing a new botanical garden, or that the botanical library and herbarium of Columbia University, dating back to pre-colonial King's College, should today be situated at The New York Botanical Garden.
>
> The land occupied by The New York Botanical Garden is likewise of considerable historical interest. The Bronx River Gorge and Falls are situated in a 40-acre tract of original hemlock forest that has never been cut or cleared; it remains today much as it was before the first settlers arrived, and we hope to preserve it in perpetuity. In colonial days, Pierre Lorillard bought land east of the Bronx River for growing tobacco and a grist mill on the river for grinding snuff and packing tobacco. The Lorillard Snuff Mill, restored in 1954, has already been designated as a Historical Landmark by the City of New York.
>
> John Torrey, a giant among early American botanists, was responsible for the study and identification of most of the botanical specimens resulting from the boundary and railroad surverys of the western United States over a century ago. These historic specimens are now a part of the herbarium of The New York Botanical Garden, where the herbarium of Columbia University was deposited over 65 years ago.
>
> The conservatory is one of the largest and oldest in this country; in it are plants collected by prominent botanists in many parts of the world during the last century. The conservatory is used not only for the edification of the public but also to preserve species that might otherwise disappear from their own natural habitats because of cultivation and grazing. Our outdoor plantings likewise represent vegetation from all parts of the world. For example, the collection of white pines from the various isolated mountain ranges of central Europe are used widely in this country by forest geneticists because of the trees' high resistance to the white pine blister rust.
>
> These are a few of the many validations of integrity that merited the designation "Registered National Historic Landmark" for The New York Botanical Garden, an undisturbed area of great natural beauty and the first major botanical garden in the United States.

What is past is prologue.

—William Shakespeare

A man should keep his little brain attic stocked with all the furniture that he is likely to use, and the rest he can put away in the lumber-room of his library, where he can get it if he wants it.

— Sir Arthur Conan Doyle

Book Reviews

ANGIOSPERMS

SYSTEMATIC EMBRYOLOGY OF THE ANGIOSPERMS

By Gwenda L. Davis. viii + 528 pages; bibliography; indexed. Wiley, New York, 1966, $19.75.

When the late Professor P. Maheshwari died suddenly in May 1966, botanists grieved not only for a colleague but also for the fact that he did not live to complete his projected compendium of the embryology of angiosperms. This new book by Gwenda L. Davis therefore comes as a welcome surprise. From a bibliography of nearly 5000 entries, she has extracted the known facts and beliefs about the embryology of each and every family of angiosperms. Some families, such as the Compositae and Liliaceae, have 2 pages of description and as many as 200 references. Others, such as the Krameriaceae and Rapateaceae, are dismissed with two words: Embryologically unknown. No taxonomic interpretations are attempted, but the known facts are there, and taxonomists can make their own comparisons.

Embryological characters as such are discussed in the introduction. The author has introduced a new (at least to me) definition of crassinucellar and tenuinucellar, based on the ontogeny of the nucellus, in place of the traditional definition based on the number of layers of cells in the nucellar cap. In most cases the results are the same, but in others they are not, and she has had to introduce a new term, pseudocrassinucellar, for ovules which are tenuinucellar by ontogeny but crassinucellar by mature structure. Whether this altered terminology will be acceptable to other embryologists and to the botanical community at large remains to be seen.

Dr. Davis' book will be a standard reference for many years to come.

— Arthur Cronquist

BIOGRAPHY

THOMAS NUTTALL, NATURALIST; Explorations in America 1808-1841

By Jeannette E. Graustein. 481 pages; illustrated; indexed. Harvard University Press, Cambridge, Mass., 1967, $11.95.

Thomas Nuttall was a shy, self-educated, unworldly botanist and general naturalist of the early nineteenth century; he had a good field sense of species and a keen intuition for natural relationships. His talents were such that if he had been willing to apply himself as devotedly to herbarium studies as to his field work, he might well have become the foremost American botanist of his time. He had the wanderlust, however, and felt more at ease in the wilderness than in the competitive bustle of herbarium study and publication. When the opportunity came, as he was nearing the age of forty, to settle down at Harvard and capitalize on his talents, he felt more burdened by the responsibility than pleased with the opportunity. After vegetating (by his own description) for eleven years at Harvard, he left in 1834 to botanize on a trip across the Rocky Mountains to the Pacific. Having foregone his position at Harvard, he then struggled under great difficulties to prepare and publish his results. In 1842 he returned to his native England to accept, reluctantly, an inheritance that required him to spend at least nine months of each calendar year in England, and his American collecting was finished.

Nuttall has been known to us through his botanical collections and publications and from the comments of his contemporaries, who were also at least to some extent his rivals. Asa Gray, his eventual successor at Harvard, mixed frequent and perhaps not entirely disinterested criticism with his judicious praise of Nuttall's then well-known accomplishments.

Now we have for the first time a full length biography of Nuttall. Professor Graustein has diligently searched out all of the records, correspondence, and other pertinent information that can be found, to come up with a sympathetic (perhaps too sympathetic) story of his life. Often she has had to deduce what Nuttall must have done on particular occasions, but she carefully distinguishes that which is known from that which must (or might) have been. The scholarship of Miss Graustein's work appears to be beyond reproach. Those who have known Nuttall as a name or as a predecessor will be highly interested in her account. Others may find it a bit heavy and beset with detail, although some of the seemingly extraneous information may be necessary for the reader not already well informed.

My only quibble is that the author is too inclined to see Nuttall as the knight on a white charger, and his contemporaries, whenever they criticized or disagreed with him, as dragons to be slain. In a modern television production, she would surely have him wearing a white hat. She seems not to realize that competition and controversy are inherent in the progress of science, and that no villain need be. But I am overstating the case. Nuttall's essential character does come through; no one who reads the book need be misinformed about the nature of the man. This will be the definitive biography.

— Arthur Cronquist

BOTANICAL HISTORY

MEMORIALS OF JOHN BARTRAM AND HUMPHRY MARSHALL

By William Darlington (Facsimile of the edition of 1849). Introduction by Joseph Ewan. (Three indices — of Persons, Ship Captains, and Plant Names—appended.) lii, xv, 585 pages; indexed. Classica Botanica Americana, edited by Joseph Ewan, Supplement I. Hafner, New York, 1967, $20.00.

Behind the quaint language of these letters from two centuries ago lies a vast and fantastically important store of basic information about the natural history of early America, concerned with both native and cultivated plants. From these letters we gain much insight into the hazards and discomforts of botanical travels in colonial times, as well as the impact of great historical events on the daily life of the persons concerned. We find letters, for example, from Benjamin Franklin, whose interest and involvement in science are well known.

This book, originally published in 1849, has always been accessible to scholars in American research libraries but, being out of print for over a century, it has not been available to individuals. I am grateful for this opportunity to recommend it warmly and with enthusiasm to everyone interested in native American plants, culture, and history. The editor, Professor Joseph Ewan, is an outstanding authority on botanical history in America; his introduction and special indices add even more usefulness and interest to this great work.

— William C. Steere

ARBUSTUM AMERICANUM: THE AMERICANUM GROVE

By Humphry Marshall (Facsimile of the edition of 1785)
and

CATALOGUE ALPHABETIQUE DES ARBRES ET ARBRISSEUX

By Humphry Marshall; Traduit de l'Anglois par M. Lézermes (Facsimile of the edition of 1788). Introduction by Joseph Ewan. xii; xx, 174 pages; xxiv, 281 pages. Classica Botanica Americana, edited by Joseph Ewan, Volume 1. Hafner, New York and London, 1967, $20.00.

Perhaps the major claim to fame of this book – and of its author – is that it was the first treatment of "forest trees and shrubs, natives of the American United States," to be published in America. That it must have provided a useful source of information in its day is indubitable; it was translated into and published in both French and German in 1788, only three years after its original appearance in English. However, its primary value and interest to us today is historical; to see the forest plants of colonial and immediately post-colonial times through the eyes of an outstanding contemporary plantsman is fascinating, as it is, likewise, to receive "some hints of their uses in medicine, dyes, and domestic economy." Also, it is a great pleasure to see an excessively rare botanical publication, of very considerable horticultural value, made available to libraries and interested individuals. As an amusing sidelight, the editor of this facsimile edition suggests discreetly that the publication of an alphabetical catalogue to which is appended an advertisement that "BOXES of SEEDS and growing PLANTS, of the Forest Trees, Flowering Shrubs, &c. of the American United States, are made up in the best manner and at a reasonable rate by the Author," was not necessarily a wholly scientific endeavor, as Marshall carried on a flourishing business in selling American seeds and plants abroad.

The editor's informative introduction provides the necessary historical perspective with which to understand the background of Marshall's pioneer book. As a minor footnote, it is surprising, in a work of this scholarly nature, to find the omission of accents on such French names as Gérard and Lézermes, especially since at least one umlaut appears in the introduction.

– WILLIAM C. STEERE

BIBLIOGRAPHY AND NATURAL HISTORY: Essays Presented at a Conference Convened in June 1964 by Thomas R. Buckman

Edited by Thomas R. Buckman. 148 pages; illustrated. University of Kansas Libraries, Lawrence, Kansas, (University of Kansas Publications, Library Series, 27) 1966, no price stated.

This group of essays and formal papers grew out of a meeting of the Rare Books Section of the Association of College and Research Libraries held at the University of Kansas in June 1964. This special session brought together scientists, scholars, and bookmen, both American and foreign, to focus attention on bibliography – including botanical illustration – in the service of natural history. Four papers deal largely with historical considerations: "The use of bibliography in natural history" by William T. Stearn (British Museum), "Two centuries of Linnaean Studies" by Sten Lindroth (Uppsala University), "The founding of Peale's Museum" by John C. Greene (University of Kansas), and "Early American botany and its sources" by Jerry Stannard (University of Colorado). Two papers stress botanical illustration: "Redouté and his circle" by Frans A. Stafleu (Utrecht), and "Illustrated botanical works in China and Japan" by Richard C. Rudolph (University of California, Los Angeles). The last three papers are shorter and more diverse: "Bibliography and the ornithologist" by Robert M. Mengel (University of Kansas), " 'Un-natural' history" by Alan Boyden (University of Kansas), and "Natural history books from a rare bookseller's point of view" by Jacob Zeitlin (Los Angeles).

As is obvious from the titles, this book places primary emphasis on botanical topics, for which reason it can be warmly recommended to the reader who wishes authoritative and readable sources of information on bibliography of the plant sciences.

– WILLIAM C. STEERE

HUNTIA: A Yearbook of Botanical and Horticultural Bibliography

Edited by George H. M. Lawrence. Volume 2; vi, 304 pages; illustrated; indexed. Hunt Botanical Library, Carnegie Institute of Technology, Pittsburgh, Pa., 1965, $7.50 paper, $8.50 cloth.

A review of the Table of Contents quickly makes obvious that the word 'bibliography' appearing in the subtitle of this yearbook must be interpreted as being much broader – and more interesting – than the uninitiated reader might anticipate, in order to include the subjects of biography and iconography. The diversity of content and the outstanding value of the book for permanent reference can be shown only by listing the papers and authors; there is no common thread or theme upon which to base a review: "Illustrations from Weinmann's 'Phytanthoza iconographia' in Iwasaki's 'Honzô zufu' " by Richard C. Rudolph, "A bibliographical account of L'Héritier's 'Stirpes novae' " by Günther Buchheim, "Some early American horticultural writers and their works I. John Adlum and William Cobbett" by Dorothy S. Manks, "Some recollections of Percy Train (1876-1942)" by Chester A. Arnold, "The Rev. John Laurence (1668-1732); the man and his books" by John S. L. Gilmour, "Jane Quinby (1901-1965)" by George H. M. Lawrence, "Charles Darwin and the perennial flax – a controversy and its implications" by Herbert G. Baker, "Remarkable features in book collations" by Willem D. Margadant, "John Walton (1824-1914): Artist" by Bernard E. Harkness and Mabel G. Olney, "The five bretheren of the rose: an old botanical riddle" by William T. Stearn, "Notes on some portraits of British botanists and gardeners" by Alice M. Coats, "Short-title list of acquisitions, 1964" by Carolyn J. Stanley, and five departmental studies by staff members.

As in other publications of the Hunt Library, the paper is superb, the typography is attractive, and the manufacture and binding are impeccable.

– WILLIAM C. STEERE

DICTIONARIES

DICTIONARY OF FORESTRY

Compiled by Johannes Weck. 573 pages; indexed. American Elsevier, New York, 1966, $34.00.

Based on the 1961 recommendations of the Joint FAO/IUFRO Committee on Bibliography and Terminology, this multilingual dictionary lists more than ten thousand terms in German, giving their equivalents in English, French, Spanish, and Russian. Alphabetical indexes for each of the four last-named languages are found at the end. No definitions are given. The work includes not only technical terminology related to forestry, but also contains small sections listing the vernacular names of tree species, and animal and plant forest pests.

THE DICTIONARY OF THE BIOLOGICAL SCIENCES

By Peter Gray. xx + 602 pages. Reinhold, New York, 1967, $14.75.

First of all, this new dictionary provides immediate access to an enormous amount of information not previously available in one place, if at all; it is a "must" for the biologist or intelligent layman who reads widely, writes general works such as texts, is engaged in editorial work or who, for other reasons, must cover broadly the animal and plant sciences. Not indicated by the title is the fact that this work is as much a thesaurus for biology as it is a dictionary. As people do not generally read introductions and forewords, and especially instructions, alas, this book will sit on many a shelf for many a moon before the owner discovers belatedly for himself that compound

words are entered under the principal part of the compound, almost always the suffix, in order to bring words of related meaning together, irrespective of their normal alphabetical order.

The dust-jacket blurb indicates that this work was "conceived as the primary English-language reference source for the total life sciences spectrum," and that Professor Gray "is sole author of the more than 40,000 definitions," two statements that would seem to be mutually irreconcilable because no one person, no matter how extraordinarily able, could cover so broad a scope with the same degree of accuracy throughout, even with a panel of reviewers. The author's extensive experience as a professional zoologist is shown by the predominantly zoological emphasis and content of this volume; botany is definitely on the weaker side, both in coverage and in quality of definitions.

The definition of clamp cells under the entry Basidiomycetae will make even a strong mycologist weep. Peyotl (but not peyote) is defined simply as "The cactus *Lophophora williamsii,*" without further specification or cross reference, even in this psychedelic age – and the word "halucinogenic" does not appear, in spite of its current application to mushrooms and other plants. Under the series of entries under "-moss," club-moss does not appear (or elsewhere as an entry), although such entries as Lepidophyta and Lycopodiaceae are defined in this very term.

Consistency is a sometime virtue, yet one does expect greater standardization in a dictionary than elsewhere. Under the entry "-lime" we find *Tilia platyphyllos,* whereas under "linden," on the next page, we find *T. platyphyllus.* On page 300 is the entry "boblincoln = boblink," yet bobolink is the only form entered alphabetically. The adjectival form of the names of plant families have an especially odd ring to a botanist. For example, we find both "geraniale" and "geranialous" as adjectives for the Geraniaceae, and sapindale and sapindalous for the Sapindaceae. Most remarkable, however, is the unique adjective "tiliatecous" under the entry "jute" (page 277). Again, the definition of Apocynaceae as a "family of contortous dicotyledons" leaves much to be desired by the uninitiated. Under the same family, the spelling "dogbains" for dogbanes or dog's banes is delightfully original.

In spite of pointing out a few matters that the next printing or edition of this monumental work will correct, I consider this book to be solid, scholarly and indispensable, by a brilliant and highly respected biologist who will justly receive wide acclaim for this spectacular *tour de force.*

– WILLIAM C. STEERE

A DICTIONARY OF THE FLOWERING PLANTS & FERNS (Seventh edition)

By J. C. Willis, revised by H. K. Airy Shaw. xxii + 1214 + liii pages. Cambridge University Press, New York, 1967, $18.50.

Since 1897 Willis' dictionary has been a standard reference work for the spelling and taxonomic disposition of generic names, and for various other data. The fact that it went through six editions in a third of a century amply demonstrates its value. The 6th edition was published in 1931, when Willis was 63 years old, and he lived on in quiet retirement until 1958.

The 7th edition has been prepared by H. K. Airy Shaw, with the assistance of a number of other botanists, mostly staff members at the Royal Botanic Gardens, Kew. R. E. Holttum is responsible for the vascular cryptogams.

The new edition has been completely recast, as was probably necessary because of the long interval since the 6th edition. Family limits have been carefully reconsidered, and many new or newly accepted families have been added. All of the accepted families, and many of the larger genera, are described, as in previous editions. The number of new entries is surprisingly large. In compensation for the new material, and also because of the new author's own predilection, the entries for botanical terms, common names, and economic products have been deleted. Even so, the new edition has nearly half again as many pages as the previous one.

Perfection is, of course, an unattainable ideal. Given the present state of botanical knowledge, no dictionary can effectively settle the status and taxonomic position of all generic names. Recognizing this fact, the author has frequently indicated that a particular genus is of doubtful status, being held as distinct by some botanists, and reduced to synonymy by others. I could wish he had done so more often. I find it surprising that one with such narrow views on the limits of families should uncritically accept the wholesale (and in my opinion wholly unjustified) lumping of genera in the Simaroubaceae by one recent author. In other families of which I have some knowledge, the author has caught some recent changes in generic concepts, but missed others. Such inconsistencies are an inescapable part of the penalty for trying to keep up to date without being able to devote enough time to develop independent opinions on each group. Obviously the author cannot do a *Genera Plantarum* in the course of compiling a dictionary. He has done a good job, but we should not expect the impossible, nor should we accept the taxonomic information automatically and without reservation.

The new edition will continue to serve effectively the traditional principal purposes of Willis' dictionary. Botanists everywhere will welcome the fact that the dictionary has been brought up to date and that many previously overlooked or ignored names have been added.

– ARTHUR CRONQUIST

EVOLUTION

A MOLECULAR APPROACH TO PHYLOGENY

By Marcel Florkin. 176 pages; illustrated; indexed. American Elsevier, New York, 1966, $13.00.

For centuries, man has been deeply interested in his past. The child's question, "Mommy, where did I come from?" has roots which extend back throughout time, and variations on this question have formed part of the speculations, arguments, and even wars which philosophy and religion engendered. In this century, the speculations on the origin of man and the evolution of all animals and plants have bypassed religious considerations, focusing instead on careful examinations of the structure, physiology, and biochemistry of extant organisms as the basis for unravelling the pathways of evolution and discovering the interrelationships among organisms.

The use of biochemical criteria as a phylogenetic aid is a fairly new addition to the student of phyolgeny, evolution, and taxonomy. Not only did the tools and concepts have to be developed, but a sufficiently large body of data had to be obtained to make speculations possible. Even today, the gaps in our biochemical knowledge are sufficiently large and sufficiently numerous to render firm conclusions on the interrelationships among plants or animals difficult to make. Nevertheless, the work has been started, and an impetus given. The future of biochemical phylogeny and taxonomy is bright and exciting.

Professor Florkin, one of the early workers in this field, is a distinguished scientist, author, and editor. This small volume discusses the work of many laboratories, and details the state of our present knowledge in the field. It deals mainly with animals, a limitation which is to be regretted; there is a large amount of information on plants which has not been covered. The professional botanist, zoologist, microbiologist, and biochemist can profit from reading this book. It can be hoped that they will become sufficiently interested in this area of biology to start some research.

– RICHARD M. KLEIN

LOWER PLANTS

THE CELLULAR SLIME MOLDS (Second edition)

By John T. Bonner. 205 pages; illustrated; bibliography; indexed. Princeton University Press, 1967, $7.50.

Although the cellular slime molds have been known for about one hundred years, only a few biologists had shown much interest in them until the first edition of *The Cellular Slime Molds* was published in 1959. In the six years since then, a large number of experimental biologists have discovered the fantastic research possibilities of cellular slime molds as tools in research on living protoplasm. Thus a second edition became necessary to keep abreast with the increased knowledge. The number of references on cellular slime molds jumped from 124 to 341, requiring rewriting of more than half the book. The book begins with a brief introduction of "aggregated organisms" which include the "true" slime molds, the cellular slime molds and allied organisms. Then follows a survey of the kinds of cellular slime molds which are embraced in a single order, the Acrasiales. A chapter on growth includes the methods of obtaining and studying the organisms. Since much of the recent research has been on development (growth, morphogenetic movements, differentiation), this aspect is given a detailed review. The bibliography attempts to give a complete list of references on the biology of the Acrasiales through 1965. Line drawings and eight plates of photographs complement the discussions. At appropriate points throughout the book Dr. Bonner indicates where additional research is needed and suggests new lines of experiments that should be investigated. The book is more than just a review of our knowledge of the cellular slime molds. It includes much of Dr. Bonner's own research and his personal experience with them.

– CLARK T. ROGERSON

FLORA OF THE SEA

By C. L. Duddington. 207 pages; illustrated; glossary; indexed. Crowell, New York, 1967, $6.95.

There has been a need for a book on the seaweeds and other algae of the oceans written in terms that amateur botanists, beginning students, and laymen could readily understand. Dr. Duddington has provided a book that fulfills the need. After an introduction about algae, "the first of the plants," the author traces the structural and physiological development of algae from the simplest of one-celled organisms through an increasingly complex series of species to the largest and fully differentiated multicellular seaweeds. Excellent photographs (two in color) and line drawings clarify the discussions. In addition to information about the different kinds of algae, discussions on algae in partnership, algae as plants or animals, how algae live, algae at home, and the uses of algae are provided. While the species that are used as representative examples are those found in the sea near Great Britain and western Europe, most of these occur also along the Atlantic coast of North America. The book will be a useful and enjoyable introduction to anyone interested in plants of the sea particularly in temperate regions.

– CLARK T. ROGERSON

FUNGI

By Lilian E. Hawker. 216 pages; illustrated; indexed. Hillary, New York, 1967, $2.50 paper.

This is a paperback edition of *Fungi*, first published in 1966. The author is a leading English mycologist. The book is subtitled "An Introduction"; it was written primarily for university students at the undergraduate level. A very concise account of the fungi is presented. For each major group (order) a representative species, usually one occurring in Great Britain, is discussed. Stress is given to morphology and life cycle. In the introductory chapter a brief review of the fungal cell, growth and development, life cycle, asexual and sexual reproduction, physiology, and classification is presented. Part I (about one-half of the book) treats the lower fungi (Phycomycetes) in which five classes are recognized. Part II deals with the higher fungi (Ascomycetes and Basidiomycetes). In both parts Dr. Hawker has accepted many of the recent proposals to modify classification, thus indicating that she has kept abreast with recent research. The Fungi Imperfecti are briefly considered with the Ascomycetes. Only a limited number of semi-diagrammatic line drawings are included. References are limited primarily to reviews and books. In the concluding brief chapter, Dr. Hawker presents her views on the evolution and phylogeny of fungi. For the college student taking a course in botany or mycology the book should be a helpful, quick-reference adjunct to a more comprehensive textbook.

– CLARK T. ROGERSON

THE LIFE OF YEASTS

By H. J. Phaff, M. W. Miller, and E. M. Mrak. 186 pages; illustrated; bibliography; glossary; indexed. Harvard University Press, Cambridge, Mass., 1966, $5.50.

As indicated in the preface, this book on yeast was written to serve the non-specialists who occasionally come in contact with these micro-organisms and wish to learn something about them. The book is a goldmine of information. Nowhere else can a person so readily find pertinent information so quickly. For example, under ecology one finds information about yeasts as they occur in nature along with their complex interactions with other organisms, and about yeasts associated with plants (leaves, flowers, tree exudates, and as plant pathogens), yeasts associated with animals (mammals, rodents, insects, etc.) including beneficial and harmful aspects, yeasts occurring in soil, and yeasts occurring in water. To obtain this information heretofore would have required a long tedious search through the scattered literature. The authors, all of whom are specialists on yeasts, have done a remarkable job. In eleven chapters, thorough and well-written digests on the history of our knowledge of yeasts, their morphology, cytology, sporulation and life cycles, genetics, metabolic activities, nutrition and growth, ecology, fermentation processes (including spoilage of food), industrial uses, and classification are discussed. Additional attributes of the book are two appendices listing (1) the yeast genera and their diagnoses, and (2) principal characteristics of the yeast genera, as well as a selected bibliography and a glossary of certain mycological terms. Line drawings and excellent photographs clarify many aspects of the discussions. The book will certainly prove to be a vital and useful source of information for not only the non-specialists and students but for the specialists in botany, zoology, biochemistry, and allied fields.

– CLARK T. ROGERSON

NON-FLOWERING PLANTS (A Golden Nature Guide)

By Floyd S. Shuttleworth and Herbert S. Zim. 160 pages; color illustrations; indexed. Golden Press, New York, 1967, $3.95 cloth, $1.00 paper.

Here is a pocketbook which everyone interested in nature should have. It is filled with well-executed, colored illustrations of a large number of common, non-flowering plants. All major groups of algae, fungi (including bacteria and slime molds), lichens, mosses, liverworts, hornworts, ferns, fern allies (club mosses, horsetails, etc.), and gymnosperms are considered. Information on relationships, distribution, activities, methods of study, and collecting techniques is given in the introduction. Throughout the book the plants are referred to by common names only. The scientific names are listed at the end; some of these are misspelled. For identification one must rely on the colored illustration and a very brief and terse description. Thus positive identification for many of the plants is not possible. Still, one can become familiar with a wide range of groups and kinds of flowerless plants.

THE OXFORD BOOK OF FLOWERLESS PLANTS

By F. H. Brightman, illustrations by B. E. Nicholson. 208 pages; illustrated (96 color pages); indexed. Oxford University Press, New York, 1967, $10.00.

This is a pleasing book that contains some of the best colored illustrations of flowerless plants to be published. The book was written for people of all ages who enjoy the out-of-doors and who become intrigued by the many kinds of plants without flowers – ferns, fungi, mosses, liverworts, lichens, and seaweeds (algae). The primary purpose is to help the beginner with identification. In this goal the author and the artist have succeeded admirably. Some 688 flowerless plants are described and illustrated in color; most were drawn from actual specimens. The plants are grouped according to the natural localities in which they grow. For the seashore – plants growing on sea cliffs, in the ocean at high-water mark, between the tides, low-water mark, in salt marshes and sand dunes are considered in turn. Then follow plants of grasslands (pastures and meadows, chalk down), uplands (heath, mountains, walls, moor), wet places (bog, marsh, pool, streams and streamsides), and woodlands (conifer woods, birchwoods, beechwoods, oakwoods, mixed woods). Finally, information on classification and associations is presented. The plants are identified by their scientific names; occasionally a common name (one used in England) is given also. Written by an Englishman, the book includes common flowerless plants occurring in Great Britain. Most of the species also are known from eastern North America. Thus the book can be recommended highly for American naturalists.

– CLARK T. ROGERSON

PLANTS WITHOUT LEAVES

By Ross E. Hutchins. 152 pages; illustrated; indexed. Dodd, Mead, New York, 1966, $3.50.

Leafless plants as treated in this book include the algae, fungi, slime-molds, lichens, liverworts, mosses, and horsetails. Thus, except for the club mosses and ferns, the book covers the cryptogamic plants. The author, an entomologist, presents interesting information on these plants in a popular and enjoyable language. The black-and-white photographs, most of them "close-ups," are excellent and include some of the best for clearness and accuracy that have been published. The first chapter, "Meet the Leafless Plants," provides an introduction. Succeeding chapters cover algae, "The First Plants"; fungi, "Believe - it - or - not Plants"; slime - molds, "Plants or Animals?"; lichens, "The Pioneers"; liverworts, "The Creeping Plants"; mosses, "Plants with a Past"; and horsetails, "The Living Fossils." Apparently the author was quite intrigued by the lichens – three chapters, including one on uses, are devoted to them, while the other groups are allocated a single chapter each. Only a few of the plants discussed or illustrated are identified to species. Most are referred to with generalized names; some are referred to by generic names; a few by specific common names. A few technical errors were detected. The correct name of the earth star is *Geastrum hygrometricus*, not *Geaster hydrometricus*. The red snow alga is not called Chlorophyta – it belongs to the division Chlorophyta. For a pleasant and useful introduction to leafless plants, the book can be highly recommended.

– CLARK T. ROGERSON

POLYPORACEAE OF NORTH AMERICA. THE GENUS PORIA

By Josiah L. Lowe. 183 pages; illustrated; indexed. State University College of Forestry, Syracuse, New York, Technical Publication No. 90, 1966, $1.50 paper.

This is the second part of a monographic treatment of the Polyporaceae of North America by America's leading authority on these fungi. The first part (published in 1957) covered the genus *Fomes;* this part covers a larger and more complex genus, *Poria.* A technical account of all species known from North America is presented; in reality most of the species known from the world are discussed. Keys, descriptions, synonyms, pertinent references, habitats, distribution, and economic importance are included for each species. Line drawings of important microscopic structures illustrate the species. In effect this is a manual for the identification of species of *Poria.* Since all species occur on wood or living woody plants and are active in the breakdown and decay of wood and wood products, the manual will be useful to the forester and the forest pathologist, as well as to the mycologist.

– CLARK T. ROGERSON

SUPPLEMENT TO SMITH'S MARINE ALGAE OF THE MONTEREY PENINSULA

By George J. Hollenberg and Isabella A. Abbott. 130 pages; illustrated; indexed. Stanford University Press, Stanford, Calif., 1966, $3.50.

Since Smith's work appeared over twenty years ago, 55 new species of algae have been added to the Monterey area flora, and knowledge of algal distribution, structure, physiology, and reproduction has been much extended. This book updates Smith without changing his taxonomic sequence or format. The emphasis in the 259 entries is on describing new genera and species (cross-referenced in detail to the sections in Smith) and on changes in nomenclature.

THE THELEPHORACEAE OF NORTH AMERICA

By Edward Angus Burt; new introduction by A. L. Welden. 730 pages; illustrated. Originally published 1914-1926; facsimile reprint from the original papers, Hafner, New York, 1966, $22.50.

One of America's outstanding mycologists was Edward Angus Burt (1859-1939). Throughout most of his professional life he worked at the Missouri Botanical Garden, St. Louis, and devoted his time to the task of monographing the large and complex family of fungi, the Thelephoraceae (Basidiomycetes). Members of this family occur for the most part on decaying wood or humus and hence are important in the breakdown of wood and other plant materials. The fifteen monographs of the genera were published between 1914 and 1926; most were out of print by the early 1950's. Hence mycologists are indebted to Hafner Publishing Company for reprinting the complete set, thus making it available to a new generation of mycologists. An additional bonus in the reprint is a preface by Dr. A. L. Welden which gives an interesting biographical and historical sketch of Dr. Burt and his work.

PINES

THE GENUS PINUS

By N. T. Mirov. viii + 602 pages; illustrated; indexed. Ronald, New York, 1967, $15.00.

Mirov's book provides us with the first treatment of the pines of the world on a comprehensive, biological basis. Although two major works have been published on the pines of the Western Hemisphere, their emphasis is entirely on the taxonomy of this very natural and easily recognized group of plants. The present work, however, reflects the broad interests and experience of the author, who is as much at home in the areas of plant physiology and chemistry as he is in systematic botany, geography, ecology, and forestry. Dr. Mirov could very appropriately have added as a subtitle, "In three dimensions," because of the extraordinary scope of his coverage of the pines in depth as well as in breadth, some indication of which is given by the chapter headings: (1) History – from Theophrastus to the end of the nineteenth century, (2) Paloebotanical record and paleogeography, (3) Geography, (4) Genetic aspects, (5) Morphology and reproduction, (6) Physiology and ecology, (7) Chemical aspects, (8) Chemical geography, and (9) Taxonomy. The final chapter, (10) Concluding remarks, points out many unsolved problems and unanswered questions inevitable in any major work of this magnitude, as well as guideposts and creative and constructive ideas for

future progress. For example, although he treats 105 species of pines over the whole world, he cheerfully admits that further species new to science still remain to be discovered or better defined, especially in Asia.

This book represents a synthesis of the author's research and thinking over several decades; each chapter abounds in new, stimulating, and creative ideas. As a pioneer and veteran worker in chemotaxonomy or biochemical systematics, Dr. Mirov is at his best, in terms of new concepts and original thinking, in his chapters on chemical aspects and chemical geography. For example, he looks upon the evolutionary development and subsequent geographic distribution of chemical constituents of pines as parallel to the geographical distribution of blood groups in man – and equally important for evolutionary insights. He finally settles for all time the long-debated question of whether or not pines exist south of the Equator – *Pinus merkusii* does occur naturally in the Barisan Range of Sumatra, on Mount Penawar, 2°6′ south of the Equator. Finally, the wide distribution of alkaloids in the pines is especially surprising because this is a group of plants in which they had not been logically expected.

For the reader who is seriously interested in pines and who wants to find out all he can about them, this book provides more readable and authoritative information then has ever been available before between two covers – it is by far the best and most comprehensive resource book yet to appear on the genus *Pinus,* by the man who knows most about it.

—WILLIAM C. STEERE

ROSES

THE ROSE IN INDIA

By B. P. Pal. 265 pages; 80 color plates, 19 drawings; indexed. Indian Council of Agricultural Research, New Delhi, 1966, $12.00.

This is not a book for the beginner, but advanced rose growers will find it fascinating. Because the climate of India more closely approaches that of Hawaii and Zone 10 areas, the cultural directions are not applicable to most of America.

However, the author's knowledge of roses is encyclopedic and obviously first hand. Especially valuable is his chapter on rose breeding. Mr. Pal is President of the Rose Society of India and has devoted the major part of his spare time during the last forty years to growing roses. The fact that he has hybridized and introduced six new varieties is particularly important.

The author lists and describes 506 varieties of roses suitable for Indian conditions. Most of them will be recognized immediately by American rose growers. This is not too surprising, as the entire world has had to depend on a fairly small group of hybridists for its new roses. Since 1930 when the Plant Act was passed most of the output has come from America. To date the development of new varieties in this country has been largely a numbers game in which thousands of pollinations are made in the expectation that a few worthwhile roses will rise out of the heap. The costs are great but the returns are even greater if a new rose hits the jackpot. Mr. Pal's approach to hybridizing is more sophisticated. Instead of depending on the laws of chance he has returned to the Mendelian laws and the results will be most interesting to watch.

An interesting point made by the author is that our use of the phrase "attar of roses" for the essential oil in roses is incorrect. The phrase should be "otto of roses"; "attar of roses' should be reserved for the product prepared by distilling roses and absorbing the perfumed vapors in oil of sandalwood." "The essential oil of roses," he explains, "is not obtained directly from the distillate. Rose-water collected during the distillation is placed in shallow earthen or metallic vessels and exposed to the cold of the night air in the open, protected from dust with clean muslin cloth. Early in the morning, the fragrant butter-like material floating on the surface of the rose-water is collected by means of shells or feathers and stored in glass bottles. As the temperature rises, this becomes liquid. The colorless liquid with ageing develops an amber color."

Many authors, including this reviewer, have repeated a statement to the effect that the British in World War II collected rose hips because they were found to have 300 times as much vitamin C as fresh orange juice. Mr. Pal quotes from a British treatise which indicated that the rose-hip syrup is 3 times richer than fresh orange juice.

Measurements and formulas in the book are in the metric system, which might provide a barrier for some American readers. The only other criticism, and it is minor, is that the color plates used lavishly throughout the book are not of top quality. Many of them appear to be catalog plates that probably had better reproduction in the original catalog pages.

– MATTHEW A. R. BASSITY

SO YOU WANT TO GROW ROSES

By Veva Penick Wright. 140 pages; illustrations by Grambs Miller; indexed. Barre Publishers, Barre, Mass., 1967, $6.95.

This is one rose book we could well do without. The information is often vague, contradictory, or erroneous.

"See to it that your roses have plenty of sun." How much? On page 90 the author advises cutting faded flowers back to ¼ inch above the *first* five-leaflet on the cane. It is two pages later that she warns the reader to select a five-leaflet that will help shape the bush properly.

On page 54 the author writes: "After a bush is planted and the soil has settled, the bud union should be slightly above ground level. Keep this in mind while planting." Thirty pages later, in discussing spring pruning, she states, "Remove enough soil to expose the crown and bud union," and two pages later she tells the reader to replace the soil around the bud union. At no time is the author specific about those climatic areas where the bud union should be below ground level, at ground level, or above it. On page 94 the author takes the following position: "... to me the theory of regular protective spraying or dusting with insecticides and fungicides once a week is a way of torturing the foliage." She follows this with "When insect pests do arrive and diseases appear, the gardener can spray or dust for the immediate problem." This is the first and I hope the last time I hear anyone advise against preventive spraying. As a matter of fact, even the author doesn't believe this because twenty pages later she says: "Start your spraying or dusting program in the spring as soon as the leaves are well developed. Continue applications of preventive controls every 2 or 3 weeks, or as needed, until the plants lose their leaves in the fall, or after the first frost. Certain conditions may impose more frequent applications of specific controls." She even goes so far as to recommend spraying fungicides before a predicted rainfall rather than the accepted practice of spraying within 24 hours after the rainfall.

Under spring pruning, the author advises removal of suckers. Anyone who fails to remove suckers during the growing season, rather than the following spring, is courting trouble. To confuse the issue further the author points out that the leaves on a sucker are shaped differently. Leaves on a dormant rose plant! Again, under the pruning of climbing or pillar roses, the author states: "Major pruning, such as the removal of old canes, should be done immediately after the blooming season, in late June or early July." Rarely does a rose firm put on the market a climber that is not remontant, so pruning in June or July is guaranteed to remove the source of all the flowers that would normally bloom between June and October!

While roses prefer a slightly acid soil they are remarkably tolerant of both acid and alkaline soil. Yet the author states categorically that "Roses prefer a pH of 5.5 to 6.5, never higher." Hogwash.

In advising on the control of grubs in the lawn the author says, "Spray the ground with chlordane. Consult your garden specialist on what to use on your lawn to kill the Japanese beetle grub." First of all, chlordane is a specific for Japanese beetle grubs and secondly, if applied as a powder it will control this condition for three years.

The author has some very curious definitions. *Friable* is defined as "porous," and *microclimate,* which involves sun, shade, soil temperature, wind, humidity, and the movement of air, is defined simply as "air circulation."

There are many other blatant errors, such as the statement that by 1829 hybridizers had developed and named more than 2000 varieties of roses. The first edition of *Modern Roses,* published in 1930, listed only 2511 varieties. But the error that is likely to cause considerable anguish is the advice given on cut roses: "Mash one inch of the stem with a hammer to help the bloom to absorb water." Nothing can kill a rose bloom faster than blocking the passage of water up the stem.

If not a hammer, at least a blue pencil should have been used to mash this manuscript before it got into print.

— MATTHEW A. R. BASSITY

ALL ABOUT MINIATURE ROSES

By Ralph S. Moore. 136 pages; illustrated; indexed. Diversity Books, Grandview, Missouri, 1966. $5.95.

The author, a West Coast plant hybridizer and nurseryman, has prepared this small volume for the amateur miniature-rose enthusiast. Despite the title this work is not an inclusive treatment of miniature roses; rather, it reflects the author's personal experiences with these interesting plants.

THE CONCISE HANDBOOK OF ROSES

By Eigel Kiaer. 111 pages; illustrated; indexed. E. P. Dutton, New York, 1966. $5.95.

This book, first published in Denmark in 1965, now appears in English, translated by Dr. Gwynne Vevers, Curator of the Aquarium at the London Zoo. The author is a Danish landscape gardener.

The volume presents in detail the various horticultural aspects of rose growing and gardening; and there is a very interesting section on the "Cultural History of the Rose." Also included are 64 pages of colored illustrations of rose varieties by Verner Hanke, followed by an alphabetical list of these varieties, giving a brief description of the flower and plant.

Books Briefly Noted

BOTANY

ADAPTATION AND NATURAL SELECTION

By George C. Williams. 307 pages; bibliography; indexed. Princeton University Press, Princeton, N. J., 1966. $6.50.

The author, Associate Professor of Biology at the State University of New York, Stony Brook, presents a critical review of current scientific thought concerning evolutionary adaptation and natural selection. Many examples are included to illustrate adaptation from the author's point of view. Technical in nature, the book was written for advanced students of biology or professional biologists.

CHROMOSOME MANIPULATIONS AND PLANT GENETICS

By Ralph Riley and K. R. Lewis. 123 pages; illustrated; indexed. Plenum Publishing Corp., New York, 1966. $8.00.

Issued as a supplement to *Heredity,* Volume 20, 1965, this is made up of the papers presented at a symposium which formed a part of the Section for Cytology and Genetics of the Tenth International Botanical Congress held in Edinburgh, Scotland, in August 1964. The papers deal with various aspects of chromosome research in higher plants, namely tobacco, tomato, potato, wheat, oats, and cotton. The discussions reflect the great interest in cytogenetical methods of improving agricultural crops.

COMPARATIVE PHYTOCHEMISTRY

Edited by T. Swain. 360 pages; illustrated, charts and graphs; indexed. Academic Press, New York, 1966, $14.75.

The chapters are based upon the papers presented at a NATO-supported meeting of the Phytochemical Group in Cambridge, England, in April 1965. Each chapter deals with some aspect of the study of chemical distribution and biogenesis in plants. The goal of this research is to determine the possibilities of using phytochemical techniques in plant classification. Extensive bibliographies accompanying each chapter make this work a valuable survey of current research in this area.

CYTOLOGY (2nd edition)

By G. B. Wilson and John H. Morrison. 319 pages; illustrated indexed. Reinhold, New York, 1966, $8.50.

This is the second edition of a textbook first published in 1961. The text has been revised and updated where necessary. New illustrations and references have been added to those in the earlier edition. The work covers in detail the structure and function of the many components of the cell, and also deals with fields of research, such as cytogenetics, radiation cytology, and laboratory cytological techniques. G. B. Wilson is Professor of Botany and Plant Pathology at Michigan State University. John H. Morrison is Associate Professor of Biology at Kent State University in Ohio.

ECOLOGY AND FIELD BIOLOGY

By Robert Leo Smith. 686 pages; illustrated; indexed. Harper & Row, New York, 1966. $12.75.

Designed as a college textbook, this book deals in detail with ecology and related areas of biology as applied to field studies. The text is divided into five major sections: The Ecosystem and Community, Aquatic and Terrestrial Habitats, Population Ecology, Natural Selection and Specialization, and Behavior of Animals.

The author is a teacher at West Virginia University and Wildlife Biologist at the West Virginia Agricultural Experiment Station.

FLORAL BIOLOGY

By Mary S. Percival. 243 pages; illustrated; indexed. Pergamon Press, Long Island City, New York, 1966. Paperback $3.85.

Written for the college student, this compact work is devoted to the study of "the science of flower life" and is aimed at attracting new researches into this field. The text discusses sex in flowers, the morphology of the flower, pollination and pollinating agents, and animal foods occurring in flowers. A brief section of references and a bibliography complete the work.

LABORATORY TECHNIQUES IN BOTANY

By M. J. Purvis, D. C. Collier, D. Walls. Second edition; 439 pages; illustrated; indexed. Butterworth, Inc., Washington, D. C., 1966. $11.50.

Designed as a manual for the use of laboratory technicians, research workers, college students, and teachers, the first edition of this work appeared in 1964. This second edition has been revised to include many new techniques and also information not included in the scope of the first edition. The techniques are discussed in great detail, each chapter is well illustrated with drawings and photographs and includes a bibliography.

MORPHOLOGY OF PLANTS (2nd edition)

By Harold C. Bold. xix + 541 pages; illustrated; indexed. Harper & Row, New York, 1967, $12.75.

The first edition of this textbook by a well-known algologist and morphologist was published in 1957. The new edition has been revised extensively to take account of new information and new interpretations, and there are many new and improved illustrations. Comments on fossils are now associated with the proper groups, instead of being relegated to a section at the end. The method of ex-

emplifying groups by treating particular genera in detail is retained, but more information about each group as a whole is now included. The new edition is a better book than its predecessor and should find wide acceptance.

— ARTHUR CRONQUIST

NATURAL PEST CONTROL AGENTS (Advances in Chemistry Series No. 53)

Edited by Robert F. Gould. 146 pages; indexed. American Chemical Society, Washington, D.C., 1966. $5.75.

This volume contains the papers presented at a symposium sponsored by the Pesticides Subdivision of the Division of Agricultural and Food Chemistry at the 149th meeting of the American Chemical Society, Detroit, Michigan, April 8, 1965. These highly technical papers deal with that part of pesticide research concerned with the substances naturally produced by plants or animals which have pest-control properties. Of particular interest are chapters on "Crystalliferous Bacteria as Insect Toxicants," "Some Antifungal Factors in Barley," "Virus Replication Inhibitors and Stimulators from Plant Sources," and "Regulation of Plant Growth by Constituents from Higher Plants."

PHYLOGENETIC SYSTEMATICS

By Willi Hennig (translated from the German by D. Dwight Davis and Rainer Zangerl). 263 pages; illustrated; indexed. University of Illinois Press, Urbana, 1966, $12.50.

The relationship between phylogeny and taxonomy, once thought to be settled as a harmonious and indissoluble marriage, has recently shown such signs of strain that many taxonomists have seen some need for a loosening of the ties, and some even propose a friendly divorce. The present work is an argument for maintaining such a close relationship that neither partner is permitted even to indulge a roving eye. Changing a metaphor, I believe that taxonomy can at best present only a muddy reflection of phylogeny, rather than a precise image, and I find the argument and assumptions of this book unrealistic. That does not prove that I am right or that the author is wrong.

The book is an English translation of a revised and updated manuscript based on a book published in German in 1950. There is no German equivalent of the new edition, which therefore stands on its own as an English-language book. The author is an entomologist, and most of his examples are drawn from the insects; plants are mentioned infrequently. The book is heavy going, and will be of interest chiefly to professional taxonomists.

— ARTHUR CRONQUIST

PLANT BIOCHEMISTRY (revised edition)

By Geza Doby. 768 pages; tables; indexed. John Wiley & Sons, New York, 1966, $25.00.

This technical treatise in its revised edition has been translated into English by I. Finaly. It covers in detail the entire field of plant biochemistry. Each chapter is accompanied by a bibliography covering the important literature pertinent to the subject under consideration. References are cited through 1962. This volume will be of greatest value to the advanced student or professional biologist who desires a thorough survey of the field.

PLANT BIOLOGY TODAY: ADVANCES AND CHALLENGES

Edited by William A. Jensen and Leroy G. Kavaljian. Second edition; 128 pages; illustrated. Wadsworth Publishing Co., Belmont, California, 1966. Paperback $2.95.

A survey of the current status of botanical research, this work enumerates many of the "problems of immediate importance in the plant sciences." The papers from which the chapters were prepared were presented by specialists at symposia sponsored by the American Association for the Advancement of Science and the Botanical Society of America.

PLANT DIVERSIFICATION

By Theodore Delevoryas. vii + 145 pages; illustrated; indexed. Holt, Rinehart and Winston, New York, 1966, $2.25 paper.

It is the vogue nowadays to publish a paperback series of small textbooks, each covering some restricted segment of the field of botany or biology. This little book is part of the Modern Biology Series. It presents the sort of material on evolutionary diversification and broadscale classification of plants that used to make up a considerable part of general botany textbooks, but which has been slighted in many recent ones. It is a clearly written, workmanlike job which reflects current thinking on the phyletic relationships of the major plant groups.

— ARTHUR CRONQUIST

THE PLANT IN RELATION TO WATER

By R. O. Knight. 147 pages; illustrated; indexed. Dover, New York, 1965, $2.75.

Designed for use in British secondary schools, this book should be of value in high schools and basic college biology courses. The author deals with the physiological, structural, and ecological aspects of the plant's relation to, and interaction with, water. Laboratory demonstrations and experiments are described in the text and are indexed separately.

PLANT PHYSIOLOGY

By Robert M. Devlin. 564 pages; illustrated; indexed. Reinhold, New York, 1966, $11.00.

A college textbook intended for students with a background in botany and chemistry. The first eight chapters deal with fundamental processes; a chapter on translocation of sugars then serves as a transition to three chapters on photosynthesis, followed by treatments of mineral nutrition and growth. Chapters on photoperiodism, vernalization, and dormancy terminate this text. A clear and scholarly work with copious references.

THE PRINCIPLES OF POLLINATION ECOLOGY

By Knut Faegri and Leendert van der Pijl. 248 pages; illustrated; indexed. Pergamon, Long Island City, New York, 1966, $9.50.

The authors present – for the use of teachers, students, and naturalists – a general discussion of the basic principles underlying the study of pollination ecology. Methods and agents of pollination are described in detail and are related to the floral mechanisms of the plant. A chapter is devoted to case histories, in which descriptions of particular plants and the manner in which they are pollinated are included to illustrate the principles involved. The work is not intended to be a comprehensive manual. Knut Faegri is recognized as an authority in the study of palynology and has written extensively on this and on plant geography. Leendert van der Pijl has studied and written on the ecology of tropical plants.

TAXONOMY OF FLOWERING PLANTS (Second edition)

By C. L. Porter. 472 pages; illustrated; indexed. Freeman, San Francisco, 1967, $7.75.

The first edition of this book has had some success as an auxiliary textbook, to use along with a local or regional flora, in an introductory taxonomy course. It covers basic floral and vegetative morphology, the characters of common families and orders, and a modicum of taxonomic theory. There are enough changes in the second edition so that the type appears to have been completely reset, but the changes are minor and do not significantly affect the coverage and basic outlook. Those who found the first edition useful will also be pleased with the second. Those who objected to one or another feature, including the arrangement of families and orders, will find no reason to change their minds.

— ARTHUR CRONQUIST

VIRUSES OF PLANTS

Edited by A. B. R. Beemster and Jeanne Kijkstra. 342 pages; illustrated; indexed. John Wiley & Sons., New York, 1966. $12.75.

Contained in this volume are papers presented at the symposia and lectures of the International Conference on Plant Viruses, held at Wageningen, The Netherlands, July 5-9, 1965. The papers deal with many aspects of plant virus research and include the mechanism of plant virus infection, isolation and purification of plant viruses, reaction in plants caused by viruses, characterization of plant viruses, and the synthesis of viral protein and viral nucleic acid.

PARTICULAR PLACES AND SUBJECTS

THE ALOES OF TROPICAL AFRICA AND MADAGASCAR

By Gilbert Westacott Reynolds. 537 pages; illustrated (half color); indexed. Distributed by Edwin A. Menninger, Stuart, Florida, 1966. $14.75.

An exhaustive study of the genus *Aloe* occurring naturally in tropical Africa, Arabia, and Socotra. Species are arranged into large groups with similar characteristics. The citation of the original description, a detailed description in English, type locality, geographical distribution, and common names are given for each species. A black-and-white or color photograph accompanies each description. Imperfectly known and doubtful species are also discussed.

AN ANNOTATED BIBLIOGRAPHY OF MEXICAN FERNS

By George Neville Jones. 297 pages; indexed. University of Illinois Press, Urbana, 1966. $5.00.

This extensive bibliography, containing over 1200 citations to monographs and periodical articles, deals with the ferns and fern allies of Mexico. The volume provides an up-to-date and convenient key to the literature of this important group of crytogamous plants attributed to Mexico. While the emphasis in the selection of citations has been placed on taxonomic and phytogeographical treatments, there is much material dealing with other aspects of the literature, e.g., morphology, economic botany, ecology.

The work is arranged by author and title; citations include a brief descriptive annotation. Classified "Finding Indexes" and "Index of Personal Names" accompany the work.

CENTRAL PARK: A HISTORY AND A GUIDE

By Henry Hope Reed, Curator of Central Park, and Sophia Duckworth. 165 pages; illustrated; appendices; bibliography. Potter, New York, 1967, $5.00.

The history of Central Park is treated in the first 56 pages; on the following 75 pages are described, in two "walking tours," points of interest with comments on planting and park design. Eight appendices include one of botanical interest: "Approximate Dates of Leafing, Budding, Blossoming and Fruiting of Plants in Central Park."

THE FORESTS OF THE U.S.S.R.

By V. P. Tseplyaev (translated by A. Gourevitch). 521 pages; illustrated. Daniel Davey & Co., New York, 1966. $19.00.

Originally published in Russian in 1961, this book has been translated into English as part of the Israel Program for Scientific Translations. It deals primarily with the forest regions of the U.S.S.R. and with the subdivisions of the coniferous and broadleaf forest types. The forest composition, environment, and geographical occurrence of each of these subdivisions is described in detail. Some information concerning Russian forestry practices and forest utilization is included.

THE LIFE OF THE FOREST

By Jack McCormick. 232 pages; illustrated (mostly color); indexed. McGraw-Hill Book Co., New York, 1966. $4.95.

The author, Curator and Chairman of the Department of Ecology and Land Management at the Academy of Natural Sciences of Philadelphia, presents a non-technical but accurate and informative description of the relationships of the flora and fauna of the North American forests to each other and to their physical environment. The well-illustrated volume is the first of a projected fifteen-volume series entitled "Our Living World of Nature," produced jointly with The World Book Encyclopedia by McGraw-Hill.

MAHOGANY OF TROPICAL AMERICA—ITS ECOLOGY AND MANAGEMENT

By F. Bruce Lamb. 220 pages; illustrated; indexed. University of Michigan Press, Ann Arbor, 1966. $7.50.

The author of this up-to-date and comprehensive treatment of mahogany in the Western Hemisphere is Staff Forester for the United States Plywood Corporation, and has written several articles on mahogany and other forestry-related subjects. The volume deals not only with the silvicultural and commercial aspects of this valuable tree but also with the tree's identification, ecology, and forest associations. Included are an extensive up-to-date bibliography and an index to plant names.

MAIZE IN TROPICAL AFRICA

By Marvin P. Miracle. 327 pages; tables and maps; indexed. University of Wisconsin Press, Madison, 1966. $7.60.

This is an intensive study of one of the major crops grown in that part of Africa that separates the Sahara Desert and the Republic of South Africa. The role of maize as a food crop and as a commodity in the agriculture, diets, and economies of the region is described in great detail. Dr. Miracle is presently an Assistant Professor of Agricultural Economics at the University of Wisconsin.

THE NATIONAL PARKS OF AMERICA

By Stewart L. Udall and the Editors of Country Beautiful. 225 pages; illustrated (mostly color); appendix. G. P. Putnam's Sons, New York, 1966, $15.95.

RAND MCNALLY NATIONAL PARK GUIDE

By Michael Frome.160 pages; illustrated (color). Rand McNally, Chicago, 1967, $2.95 paper, $4.95 deluxe edition.

THE APPALACHIAN TRAIL; Wilderness on the Doorstep

By Ann and Myron Sutton, foreword by Stewart L. Udall. 180 pages; illustrated; appendices; bibliography; indexed. Lippincott, Philadelphia, 1967, $4.95.

The first two books are guides to our 32 national parks. The McNally guide, though less expensive, has more practical information for the vacationer and it has more maps. For each park there is information on accommodations, main attractions, weather, etc. The Sutton book describes America's most famous hiking trail.

THE NATURAL HISTORY OF PALMS

By E. J. H. Corner. 393 pages; illustrated; indexed. University of California Press, Berkeley, 1966. $12.95.

The author, Professor of Tropical Botany, University of Cambridge, England, presents in this volume a study of the palms, their history, evolution, morphology, geographical distribution, identification, and classification. Numerous drawings and a section of black-and-white photographs illustrate the text. A brief glossary and a bibliography are included.

THE NEW FIELD BOOK OF FRESHWATER LIFE

By Elsie B. Klots. 398 pages; illustrated; indexed. G. P. Putnam's Sons, New York, 1966. $4.95.

This manual describes the flora and fauna of freshwater lakes, rivers, ponds, and streams. The natural history of the communities and the organisms of which they are composed are discussed and identified. Numerous keys and illustrations make the book suitable for field identification. Dr. Klots has taught botany, zoology, and limnology at several colleges.

ORCHIDS OF THE WEST

By Rica Erickson. Second edition; 107 pages; illustrated (part color); indexed. Distributed by Sport Shelf, New Rochelle, New York, 1966. $8.50.

This, the second edition of a work originally published in 1951, describes the orchids of western Australia, provides keys to each species, and includes with each group a brief description of the environment and natural history of the plant. Color plates and black-and-white drawings accompany each section.

PATTERNS OF LIFE: THE UNSEEN WORLD OF PLANTS

By William M. Harlow. 128 pages; illustrated; not indexed. Harper & Row, New York, 1966. $6.95.

An attractive volume containing over 80 excellent black-and-white photographs of the myriad shapes, forms, and patterns, not easily discernible to the unaided eye, which naturally occur in plants. This volume will be of interest not only to the plant enthusiast but also to those interested in art and design. The author, a member of the staff at the State University College of Forestry, Syracuse, New York, exhibits in this book his ability and interest in nature photography. Dr. Paul B. Sears contributed the prologue to the work.

PEANUTS: PRODUCTION, PROCESSING, PRODUCTS

By Jasper Guy Woodroof. 291 pages; illustrated; indexed. The Avi Publishing Co., Westport, Conn., 1966. $14.50.

This comprehensive survey of the technology of the peanut industry in the United States will be of most interest to the agricultural economist, whom it will serve as a handy reference work. The chapter dealing with the culture of peanuts will be of value to the plantsman.

PLANT LIFE IN WEST AFRICA

By G. W. Lawson. 150 pages; illustrated; indexed. Oxford University Press, New York, 1966. $3.60.

This volume, one of the Oxford Tropical Handbooks, presents a concise, up-to-date description of the vegetation and plant life of West Africa. No attempt has been made to describe in detail the flora of the region; rather, a general description is given of the vegetation in different environments, i.e., deserts, savannas, forests. Various aspects of plant biology and current and future research in plant science in West Africa are discussed.

PLANTS AND MAN ON THE SEYCHELLES COAST. A Study in Historical Biogeography

By Jonathan D. Sauer. 132 pages; illustrated; indexed; appendices; bibliography. University of Wisconsin Press, Madison, 1967, $5.00.

The author, Professor of Botany and Geography at the University of Wisconsin, introduces us to the area (whose chief crops are copra and coconut oil) with a short history and economic geography of the islands. He then describes historical changes in the vegetation, furnishes plant distribution patterns, and in two appendices lists aboriginal and introduced plant species. This book should be of interest primarily to the plant ecologist and botanist; it will appeal also to the economic geographer and historian.

ROCKY MOUNTAIN FLORA

By William A. Weber. 437 pages; illustrated; glossary; indexed. University of Colorado Press, Boulder, 1967, $9.40.

Dr. Weber's handy little manual has been proved in actual use through two previous editions, then called *Handbook of Plants of the Colorado Front Range.* This (the third) edition has been retitled to emphasize the fact that it is useful over a considerably larger area than the Front Range, but the actual coverage has not been changed. The most obvious difference between the new edition and its predecessors is that line drawings of many of the commoner species have been added. The Englerian sequence of angiosperms families has also been abandoned in favor of an alphabetical arrangement under each of the two main groups, dicots and monocots. A number of species not previously recorded from the area have been added, and miscellaneous individual changes have been made to reflect some recent taxonomic studies and the author's own modified understanding of certain groups. The keys are, as before, nonindented, an abomination that purports to be justified by a saving in cost of production. The great strength of the manual, as in the past, is that the author knows the plants in the field, and that his keys do work. Amateur naturalists and professional botanists alike will welcome the new edition.

— ARTHUR CRONQUIST

SOME ANCIENT GENTLEMEN, BEING AN EXAMINATION OF CERTAIN PEOPLE, PLANTS AND GARDENS

By Tyler Whittle. 244 pages; illustrated by Sally Seymour; indexed. Taplinger, New York, 1966, $5.95.

Mainly a collection of reminiscences; the author holds forth in highly entertaining fashion on gardens throughout the world from the beginning of gardening to the present, on types and characteristics of gardens, on tools, materials, vegetables, herbs, flowers, fruit, ornaments, gardeners and botanists, and winds up with an alphabetical list of species mentioned.

THE STRAWBERRY: HISTORY, BREEDING, AND PHYSIOLOGY

By George M. Darrow. 447 pages; illustrated (part color); indexed. Holt, Rinehart & Winston, New York, 1966. $15.00.

A comprehensive study of the history, breeding, and natural history of the strawberry. This volume is of particular interest for its treatment of commercial strawberry breeding and breeders in the United States and abroad. Black-and-white and color photographs of works of art, plates for books, and actual plants accompany the text. Appendices include a world list of strawberry breeders, lists of varieties, and an annotated bibliography.

TEA GROWING

By C. R. Harler. 162 pages; illustrated; indexed. Oxford University Press, New York, 1966. $4.00.

This small volume presents in detail the major aspects of modern tea culture. Individual chapters are devoted to such topics as the tea plant, proper climate and soils, propagation, nurseries and planting practices, pruning, harvesting, soil management and fertilization, irrigation, and diseases and pests. The work will be a useful companion volume to Mr. Harler's earlier book, *Tea Manufacture.*

VEGETATION OF WEST VIRGINIA

By Earl L. Core. 217 pages; illustrated; indexed; bibliographical footnotes. McClain Printing Co., Parsons, West Virginia, 1966, $6.00.

The author, Chairman of the Department of Biology, West Virginia University, has written numerous books and articles on botany. In this brief survey he describes the type of vegetation found in West Virginia. The climate, geology, soils, and animals in relation to plants are considered in an introductory chapter. The book is intended as a companion volume to *Flora of West Virginia,* by Strausbaugh and Core.

List of Recent Books

(Some books listed are under review or may later be briefly noted.)

ARRANGEMENT AND DECORATION

CREATIVITY IN FLOWER ARRANGEMENT, by Frances Bode. 160 pages; illustrated; indexed. Hearthside, New York, 1967, $5.95.

DRIFTWOOD MINIATURES, by Florence M. Schaffer. 128 pages; illustrated; indexed. Hearthside, New York, 1967, $4.95.

ESSENTIAL FORMS FOR FLOWER ARRANGMENT, by Marjorie Scott Way. 184 pages; illustrated; indexed. Stephen Greene Press, Brattleboro, Vermont, 1966, $6.95.

FLOWER ARRANGEMENTS IN STATELY HOMES, by Julia Clements. 124 pages; illustrated color, black and white; indexed. Arco, New York, 1967, $9.00.

HANDBOOK OF FLORAL ART: A Complete Guide to the Arranging of Wired Flowers, by Lois Farrall. 122 pages; illustrated; indexed. Leisure Time Books, New Rochelle, New York, 1967, $5.75.

NEW DECORATIONS WITH PODS, CONES AND LEAVES, by Eleanor Van Rensselaer. 199 pages; illustrated, some color; indexed. Van Nostrand, Princeton, 1966, $6.95.

NEW TRENDS IN FLOWER ARRANGEMENT, by Rae L. Goldson. 122 pages; illustrated; indexed. Hearthside, New York, 1966, $4.95.

BIOGRAPHY

GEORGE WASHINGTON CARVER, by Rackham Holt. 360 pages; illustrated; indexed. Abingdon Press, Nashville, 1966, $2.75 paper reprint. Here is the complete story of this world-renowned genius who, born in slavery, moved forward through his own peculiar capacity for knowledge and learning to a place of friendship and esteem of eminent men and the most learned societies and scientific and humanitarian bodies throughout the world.

PLANT DETECTIVE DAVID DOUGLAS, by Bob and Jan Young. 189 pages; indexed. Messner, New York, 1966, $3.25. From the highlands of Scotland to the vast wilderness of the Pacific Northwest, David Douglas, pioneering botanist, blazed a trail in the 1800's that opened up a new era of discovery.

COOKERY AND HERBS

EARLY AMERICAN HERB RECIPES, by Alice Cooke Brown. 152 pages; illustrated; indexed. Tuttle, Rutland, Vermont, 1966, $10.00.

FREE FOR THE EATING, by Bradford Angier. 191 pages; illustrated. Stackpole, Harrisburg, Penna., 1966, $4.95. The author describes 74 edibles growing wild in North America and offers recipes for their preparation.

FRUITS OF HAWAII (4th edition), by Carey D. Miller, Katherine Bazore, Mary Bartow. 229 pages; illustrated; indexed; bibliography. University of Hawaii Press, Honolulu, 1965, $4.50. Some 300 recipes using 36 fruits grown in Hawaii.

HERBS, HEALTH AND COOKERY, by Claire Loewenfeld and Philippa Back. 320 pages; indexed. Hawthorn, New York, 1967, $5.95. Easy-to-follow everyday ways to increase beauty, eating enjoyment and health; mostly recipes.

NATURE'S MEDICINES, The Folklore, Romance, and Value of Herbal Remedies, by Richard Lucas. 224 pages; glossary; indexed. Parker, West Nyack, New York, 1966, $5.95. An account of the herbal medicines used by mankind down through the ages.

GARDENING AND HORTICULTURE

ANNUAL FLOWERS IN COLOR, by Paul F. Frese. 144 pages; illustrated, part color; indexed. Grosset & Dunlap, New York, 1966, $4.95. Homeowners' guide to the selection, use, care and cultivation of annuals.

APPROVED PRACTICES IN BEAUTIFYING THE HOME GROUNDS (3rd edition), by Norman K. Hoover. 285 pages; illustrated; indexed. Interstate Printers, Danville, Illinois, 1966, $5.00.

THE ART OF SHAPING SHRUBS, TREES AND OTHER PLANTS, by Tatsuo and Kiyoko Ishimoto. 125 pages; illustrated. Crown, New York, 1967, $3.95.

BONSAI INDOORS AND OUT, by Jerald P. Stowell. 134 pages; illustrated; indexed. Van Nostrand, Princeton, 1966, $4.95. The ancient Japanese art of bonsai explained in terms of native American plant materials.

THE COMPLETE BOOK OF GROWING PLANTS FROM SEED, by Elda Haring. 240 pages; illustrated; bibliography; indexed. Diversity, Grandview, Missouri, 1967, $7.95.

DAFFODILS, TULIPS, AND OTHER HARDY BULBS, by Michael Jefferson-Brown. 160 pages; illustrated; indexed. Branford, Newton Centre, Mass., 1966, $4.95.

FRAGRANCE AND FRAGRANT PLANTS FOR HOUSE AND GARDEN, by Nelson Coon. 232 pages; illustrated; bibliography; not indexed. Diversity, Grandview, Missouri, 1967, $7.95. Useful lists of fragrant plants in many categories, and background material for the numerous ways fragrances may be employed and enjoyed.

THE GARDEN IN WINTER, by Mina Smith. 176 pages; illustrated; indexed. Leisure Time Books, New Rochelle, New York, 1966, $5.75. Hints on how to make gardens attractive in winter.

MOISTURE GARDENING, by Alan Bloom. 125 pages; illustrated; indexed. Branford, Newton Centre, Mass., 1967, $7.95. This English book emphasizes plants which need sufficient moisture, as distinct from water or bog gardening.

NEW GARDEN BOOK (revised edition, looseleaf), by the editors of *Better Homes and Gardens.* 520 pages; illustrated, part color; indexed. Meredith, Des Moines, 1967, $5.95.

THE ORGANIC WAY TO PLANT PROTECTION, by J. I. Rodale et al. 339 pages; indexed. Rodale Press, Emmaus, Penna., 1966, paper.

WESTERN GARDEN BOOK (3rd edition), by the editors of *Sunset Magazine* and Sunset books. 448 pages; illustrated; indexed. Lane, Menlo Park, Calif. 1967, $5.95.

PARTICULAR PLACES AND SUBJECTS

THE ALPINE FLOWERS AT KOSCIUSKO STATE PARK, edited by K. G. Murray. Unnumbered pages, 16 color plates. Australian Book Center, New Rochelle, New York, 1967, $4.00. Six thousand feet above sea level is the Australian Alpine Zone and here grows a wonderful profusion of unique wild flowers.

AMERICAN ROSE ANNUAL, edited by O. Keister Evans, Jr. 246 pages; illustrated; indexed. American Rose Society, 4048 Roselea Place, Columbus, Ohio, 1967.

ANYONE CAN GROW ROSES (4th revised edition), by Cynthia Westcott. 220 pages; indexed. Collier Books, New York, 1967, $1.95 paper reprint.

DESERT PLANTS AND PEOPLE, by Sam Hicks. 75 pages; illustrated. Naylor, San Antonio, 1966, $5.95. Report on the many uses that natives of remote areas of the arid Southwest have for desert plants.

DEVOTIONALS ON FLOWERS OF THE BIBLE, by Grace P. Wellborn. 128 pages. Baker Book House, Grand Rapids, Michigan, 1967, $2.95. Companion book to *Devotionals on Trees of the Bible.*

THE ENGLISH GARDEN, by Edward Hyams; photos by Edwin Smith. 288 pages; illustrated; indexed. Abrams, New York, 1966, $3.95 paper. The very fact that the English garden never remains static, but constantly grows and changes, makes the various stages in its development a fascinating study.

ENJOYING BIRDS AROUND NEW YORK CITY, by Robert S. Arbib et al. 171 pages; illustrated; indexed. Houghton Mifflin, Boston, 1966, $4.50 cloth, $2.45 paper. The subtitle describes the book: "An aid to recognizing, watching, finding, and attracting birds in New York City, Long Island, the upstate counties of Westchester, Putnam, Dutchess, Rockland, and Orange, and nearby points in New Jersey and Connecticut."

FOREST TREES OF THE PACIFIC SLOPE, by George B. Sudworth. 455 pages; illustrated; indexed. Dover, New York, 1967, $3.00 paper reprint. Unabridged republication of the work originally published by the Forest Service of the U. S. Department of Agriculture in 1908, with new Foreword and new Table of Changes in Nomenclature.

FORMS OF NATURE AND LIFE, by Andreas Feininger. 68 pages; 169 plates. Viking, New York, 1966, $18.50. The wonders of the rich and marvelous natural world in which we live, and much of which we seldom see.

HOW WE GOT OUR FLOWERS, by A. W. Anderson. 283 pages; illustrated; indexed. Dover, New York, 1966, $1.75 paper reprint. Unabridged and unaltered republication of the work published by Ernest Benn Limited in 1951, and originally published by Williams and Norgate Limited in 1950 under the title *The Coming of the Flowers;* new index by the author.

AN INTRODUCTION TO THE SOUTH AFRICAN ORCHIDS, by E. A. C. L. E. Schelpe. 109 pages; illustrated, color; indexed. Ginn Library Services, Statler Building, Boston, 1966, $26.75. A commemorative volume designed to mark the centenary of the inception of the Bolus Herbarium.

IT'S THE PLANTS THAT MATTER, by Elaine Penwarden. 131 pages; illustrated; not indexed. Leisure Time Books, New Rochelle, New York, 1967, $6.75. Deals with every aspect of life on a small-scale general nursery near Worthing, England.

NATURE'S WONDERS IN FULL COLOR, edited by Charles L. Sherman. 252 pages; illustrated, color. Doubleday, New York, 1967, $7.50. Over 450 real life photographs and a note on nature color photography; prepared with cooperation of the National Audubon Society.

THE OLYMPIC RAIN FOREST, by Ruth Kirk and Johsel Namkung. 86 pages; illustrated, some color. University of Washington Press, Seattle, 1966, $6.95. Published in cooperation with the Olympic Natural History Association.

ORANGES, by John McPhee. 149 pages. Farrar, Straus and Giroux, New York, 1967, $4.50. The botany, history, and industry of oranges.

PASTORAL PLANTS OF THE RIVERINE PLAIN, by J. H. Leigh and W. E. Mulham. 154 pages; illustrated, part color; indexed. Tri-Ocean Books, San Francisco, 1965, $9.75. A handbook for the grazier; prepared with particular attention to the Riverine Plain, but many of the plants described are widely distributed throughout Australia.

THE PLAINS OF CAMDEBOO, by Eve Palmer. 320 pages; bibliography; indexed. Viking, New York, 1966, $6.00. The biography of a strange and beautiful African desert, by a woman who "had the good fortune to be born there."

ROSES OF YESTERDAY, by Dorothy Stemler. 55 pages, watercolors by Nanae Ito. Hallmark Card, Inc., (dist. by Doubleday), New York, 1967, $3.50. Roses of history, legend, literature, and the arts; foreword by James Gould Cozzens.

SEASHORE PLANTS OF NORTHERN CALIFORNIA, by E. Yale Dawson. 103 pages; illustrated; indexed. Also, **SEASHORE PLANTS OF SOUTHERN CALIFORNIA,** by E. Yale Dawson, 101 pages; illustrated; indexed. University of California Press, Berkeley, 1966, each $1.75 paper.

SECRETS OF FLOWERS, by A. Stoddard Kull. 64 pages; illustrated; indexed. Stephen Greene Press, Brattleboro, Vermont, 1966, $1.95. "A Remembrancer for Persons of Sensibility of Certain Facts, Fancies, Legends, and Properties of Flowers from Garden and Field."

THE WILD FLOWERS OF CALIFORNIA, by Mary Elizabeth Parsons. 425 pages; glossary; illustrated; indexed. Dover, New York, 1966, $2.25 paper reprint. An unabridged and unaltered republication of the third edition of the work, revised and corrected, as published by Cunningham, Curtiss & Welch in 1907; new Table of Changes in Nomenclature.

TEXTBOOKS

BOTANY (4th revised edition), by C. L. Wilson and W. A. Loomis. 626 pages; illustrated; indexed. Holt, Rinehart & Winston, New York, 1967, $9.95. Fourth revised edition of a 1952 textbook in college botany; updated, increased space given to intracellular biochemical events, more than 100 new illustrations.

DRAWINGS OF BRITISH PLANTS, Part XXII, Scrophulariaceae (1), by Stella Ross-Craig. 39 plates; indexed. G. Bell & Sons Ltd., York House, Portugal Street, London, W.C. 2, England, 1966, Ils. 6d paper. A new fascicule of this illustrative work is now available.

GYMNOSPERMS—STRUCTURE AND EVOLUTION, by Charles Joseph Chamberlain. 484 pages; bibliography; illustrated. Dover, New York, 1966, $2.75 paper reprint. An unabridged and unaltered republication of the work originally published by the University of Chicago Press in 1935.

A HANDBOOK OF CONIFERAE AND GINKGOACEAE (4th edition), by W. Dallimore and A. B. Jackson, revised by S. G. Harrison. 729 pages; illustrated; indexed. St. Martin's Press, New York, 1967, $35.00. A well-known reference book for more than 40 years; the present edition, the first since 1948, has been entirely reset in order to accommodate many important changes.

INTRODUCTION TO GENETICS AND CYTOGENETICS, by Herbert Parkes Riley. 596 pages; illustrated; indexed. Hafner, New York, 1967 (reprint of 1948 book), $12.50. Designed chiefly as a textbook for use in introductory courses in genetics in colleges; suitable also for the scientifically trained general reader who needs a compact authoritative summary of modern knowledge of the mechanism of heredity.

PLANT BREEDING, by Kenneth J. Frey. 430 pages; charts, tables; indexed. Iowa State University Press, Ames, 1966, $6.95. Papers from a symposium on plant breeding held at Iowa State University. The papers point out the impact of scientific discoveries of the past on plant breeding and measure the impact of eight of the other sciences on plant breeding today.

PLANTS: AN INTRODUCTION TO MODERN BOTANY (2nd edition), by V. A. Greulach and J. E. Adams. 636 pages; illustrated; indexed. John Wiley & Sons, New York, 1967, $8.50. Textbook for one-semester or one-quarter courses in general botany.

POLLEN MORPHOLOGY AND PLANT TAXONOMY: ANGIOSPERMS, by G. Erdtman. 553 pages; illustrated; indexed. Hafner, New York, 1966, $14.00. A reprint of a book first published in 1954, with an 11-page addendum on changes in terminology.

PRINCIPLES OF AGRONOMY, by Lorentz C. Pearson. 434 pages; illustrated; indexed. Reinhold, New York, 1967, $9.50. Designed to give the student who plans to major in agronomy the background he needs for further work in this field; and to give the student majoring in related fields a broad picture of the important areas of agronomy.

PRINCIPLES OF HORTICULTURE PRODUCTION, by V. R. Gardner. 583 pages; illustrated; indexed. Michigan State University Press, East Lansing, 1966, $15.00. This book attempts to provide the producer and the student with an understanding of the basic principles of fruit production.

SOIL ORGANIC MATTER (2nd English edition revised), by M. M. Kononova. 544 pages; illustrated; indexed. Pergamon, Long Island City, New York, 1966, $15.00. Textbook on the nature of soil organic matter, its role in soil formation and in soil fertility.

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Frank Clifford MacKeever

1902-1967

Frank MacKeever—"Mac" to all of his friends—was chief custodian of the herbaria of The New York Botanical Garden for nearly eighteen and a half years. He had planned to retire in September 1967 so that he might devote many anticipated years to his chief personal interests, the people and the floras of Nantucket and Martha's Vineyard. Unexpectedly and much too early death brought his work to an end.

Frank brought to the Botanical Garden a love of plants and a trained experience as a nurseryman. He studied horticulture, landscape design, and nursery production at the Connecticut State College at Storrs. For many years he owned and operated a nursery in Rowayton and served the New England region as landscape architect. This background quickly made him a popular lecturer to garden clubs throughout his years at the Botanical Garden.

In all of his custodial duties Mac was thorough and devoted. His record keeping was meticulous. He took great pride in the preparation for safe shipment of the many thousands of herbarium specimens sent out on loans and exchanges from the Botanical Garden every year, and was much concerned when returned specimens were not so well prepared. His beautiful printing and fine hand were well known to all correspondents of the herbaria. People who worked under his supervision in the shipping and mounting departments responded to his requirements for neat and orderly performance.

Frank Clifford MacKeever Custodian and Herbarium Specialist, The New York Botanical Garden, June 25, 1949-July 2, 1967.

Mac's chief joy was his field work. For nine years he assiduously studied the plants of Nantucket and Martha's Vineyard, looking forward to writing floras for the two islands. He prepared beautiful specimens, and developed a large circle of correspondents, among the principal herbaria, who were eager to receive them. Frank wrote voluminously about the islands' people and plants. Perhaps his personal warmth was most revealed in his numerous articles and letters published in the local papers about people, Indian lore, and plants. The residents of the islands responded with a genuine affection for him.

Frank's death came suddenly, bringing shock to us here at the Botanical Garden and certainly to the many others who knew him. His friends will want to know that Frank is buried, altogether appropriately with many of his forebears, under the peace and beauty of a stately white pine tree. He is survived by his wife, Olive Finch MacKeever, his married daughter, Beverly M. Langner and four grandchildren.

—Bassett Maguire

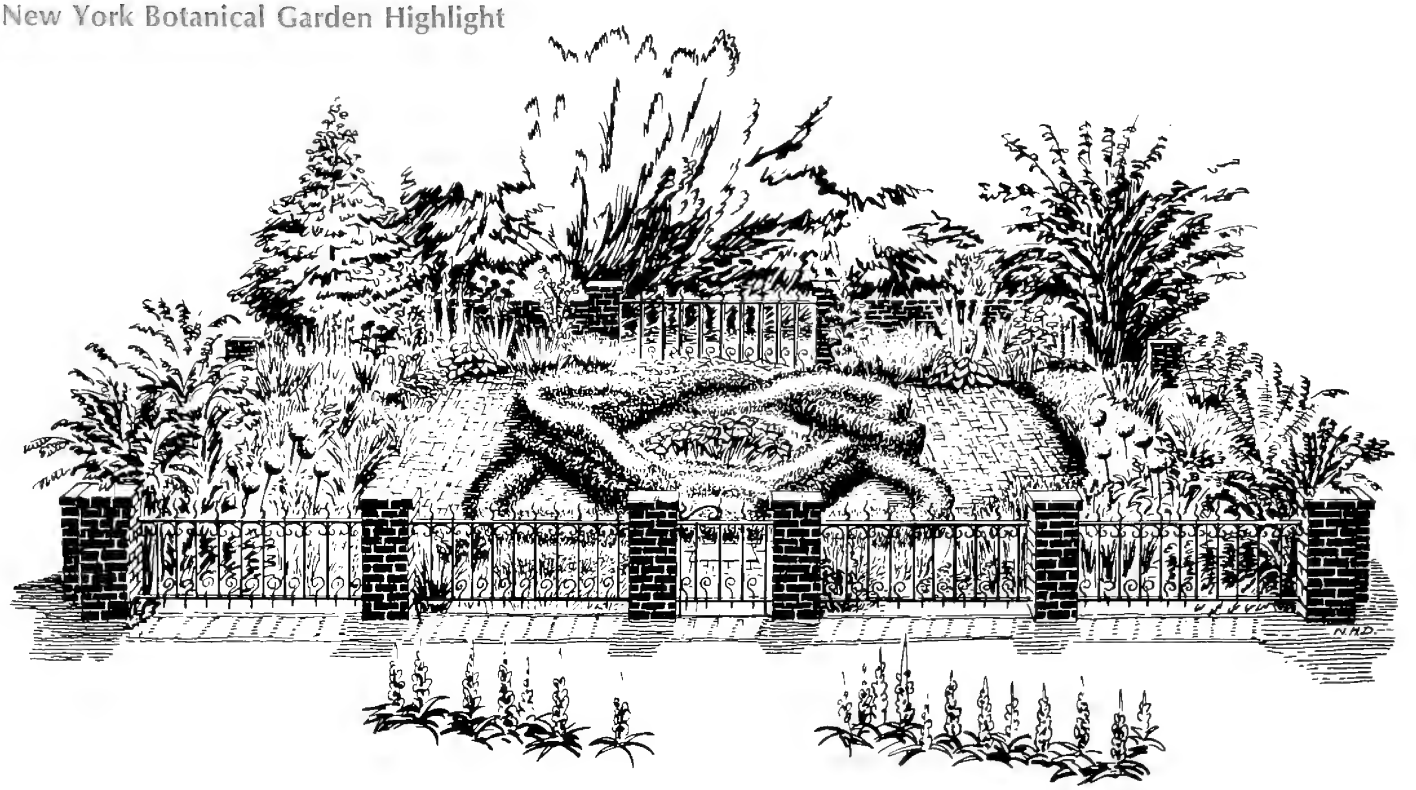
Scientific Name of the Franklinia Tree

Many *Garden Journal* readers who wrote to express their support of commemorative flower stamps *(The Garden Journal,* Vol. 17, No. 2, March/April 1967, page 65) mentioned the incorrect spelling of the botanical name of the Franklinia Tree on the illustration of the proposed design of one of the stamps. Dr. William L. Stern, Chairman, Commemorative Stamps Committee, XI International Botanical Congress, has provided the following explanation:

Through a relatively modern change of a place name, the specific epithet of a historically important American tree has been cast in doubt. *Franklinia alatamaha* was named after Benjamin Franklin by Bartram in 1785 from specimens he found growing along the banks of the Alatamaha River near Fort Barrington, McIntosh County in the State of Georgia. After Bartram's original collections the plant has never again been found growing in the wild. If the Bartrams had not made cuttings and had thereby brought *Franklinia* into cultivation, this tree would have doubtlessly become extinct.

Modern maps of Georgia show the spelling of the river to be "Altamaha," omitting the *a* before the *t* in the original spelling. This has caused considerable confusion, and not uncommonly the specific epithet is spelled *altamaha,* after the modern spelling of the river. However, this is incorrect and we are bound to accept Bartram's original spelling, *alatamaha.*

In a promotional brochure for a series of botanical commemorative stamps to be recommended to the Post Office Department, the specific epithet of the Franklinia Tree was spelled incorrectly on the proposed design. The mistake is recognized and should this design be chosen for a commemorative stamp, the name will be spelled correctly—*Franklinia alatamaha* Bartram. (See Little, E. L. 1953. Check list of native and naturalized trees of the United States. Agr. Handbook No. 41, p. 187, for further information and references.)

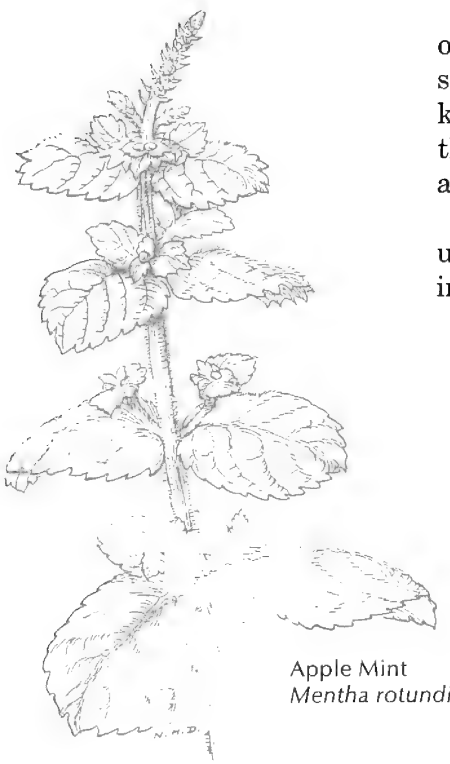


The Herb Garden

The Herb Garden (No. 28 in the photograph in the center of this issue) was designed by and is maintained with the close cooperation of the members of the New York Unit of The Herb Society of America; it is operated as part of the horticultural and educational programs of The New York Botanical Garden.

The traditional Tudor knot of herbs is the Herb Garden's central point of interest. The areas within the loops of the knot are carpeted with colored stones. The paths are laid in old brick set in a basketweave design. Many kinds of herbs grow in borders surrounding the knot. The fence that encloses the garden is of wrought iron in the form of a flame and a shepherd's crook, augmented with brick in an openwork pattern.

A booklet (not sold by mail) describing the Herb Garden and listing useful and ornamental herbs is available for twenty-five cents at the counter in the Museum Building.



Apple Mint
Mentha rotundifolia

Drawings by Natalie H. Davis

Photographs by Gottscho-Schleisner

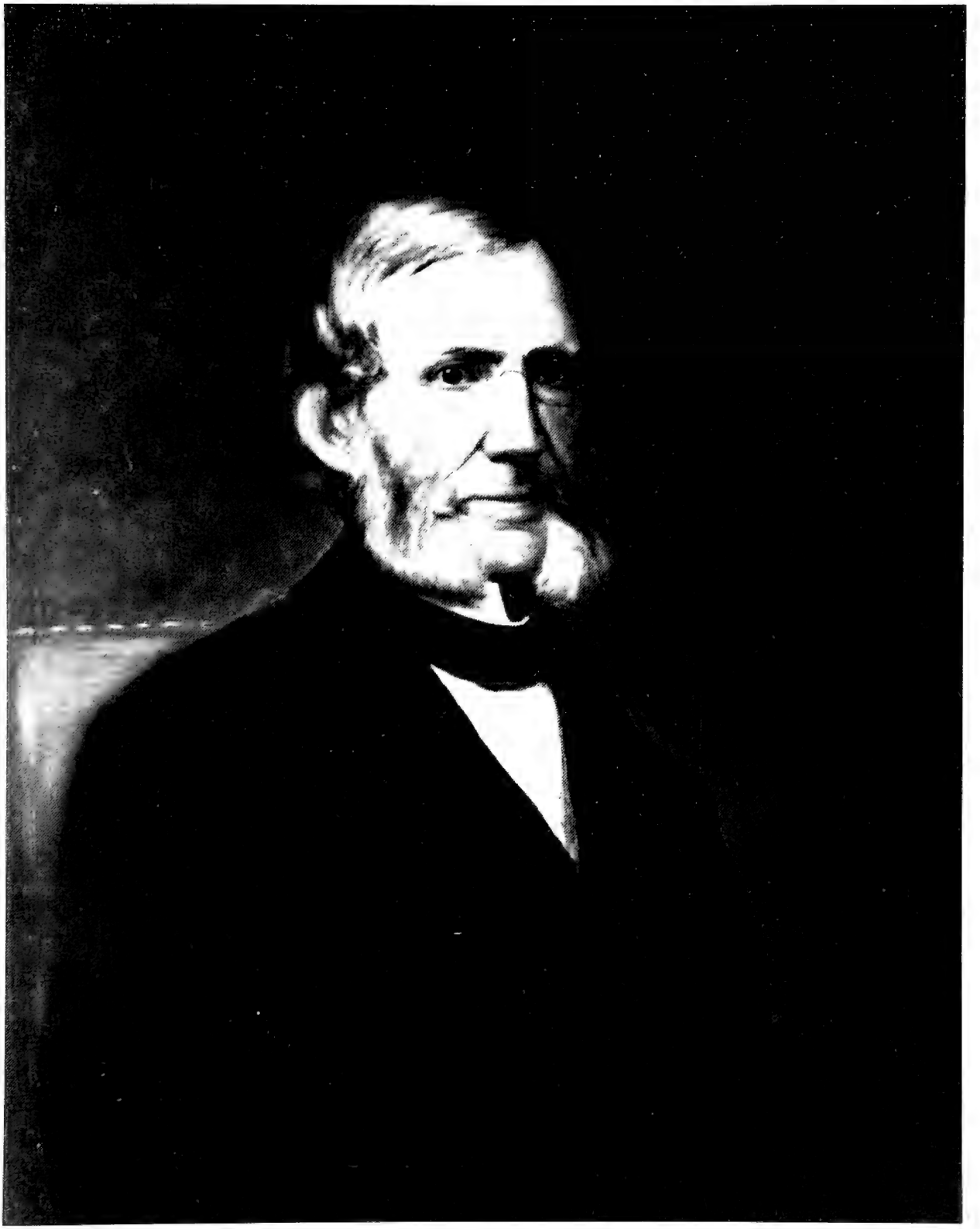
Rosemary
Rosmarinus officinalis

Lavender
Lavandula officinalis

SEPTEMBER/OCTOBER and NOVEMBER/DECEMBER 1967

Garden Journal

THE MAGAZINE ABOUT PLANTS



John Torrey

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ON ITS CENTENNIAL

A CENTURY'S MEMORABILIA

See pages 137-154.

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Vol. 17, No. 6 NOVEMBER/DECEMBER 1967

Garden Journal

THE MAGAZINE ABOUT PLANTS

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Elaine C. Cherry, Editor

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Plant-Growth REGULATORS

By Richard M. Klein

DR. KLEIN is Professor of Botany at the University of Vermont, Burlington. He was formerly Alfred H. Caspary Curator of Plant Physiology at The New York Botanical Garden.

A "convenience revolution" has simplified the life of the home gardener to the point where he hardly needs to dirty his hands. Garden-supply centers sell pill-form fertilizers, aerosol cans of pesticides, plastic sheets for mulching, automatic-watering devices, and a variety of powders, liquids, and spray cans full of seemingly magic substances to improve rooting, make plants bloom sooner, prevent fruit drop, and kill weeds. Many of these products are called growth substances, hormones, or growth regulators. What are they? What do scientists know about them?

Several compounds are called growth regulators. Fortunately they fall into fairly well-defined categories, which permits us to examine them separately. This does not mean, however, that each of them acts completely independently of the others. Living organisms are extremely complex, with check-and-balance systems that make parliamentary government seem simple by comparison. It is impossible to influence one vital growth process without altering others.

The Auxins

Plants are sensitive to light. A plant placed on a window sill bends toward the light; for this reason horticultural manuals stress the necessity for turning the plant every day or so to keep it growing vertically. The bending, called phototropism, is caused by the more rapid elongation of those cells on the side away from the light. Phototropism is a growth phenomenon.

Charles Darwin, having stirred up quite a tempest with his ideas on evolution and being in delicate health, retired to the English countryside where he embarked on a wide range of studies and experiments. One study was on the power of movement of plants. Using the sheath that encloses the first true leaf (coleoptile) of canary-grass seedlings, *Phalaris*—which is very sensitive to light—Darwin found that it would not bend toward light when the tip was re-

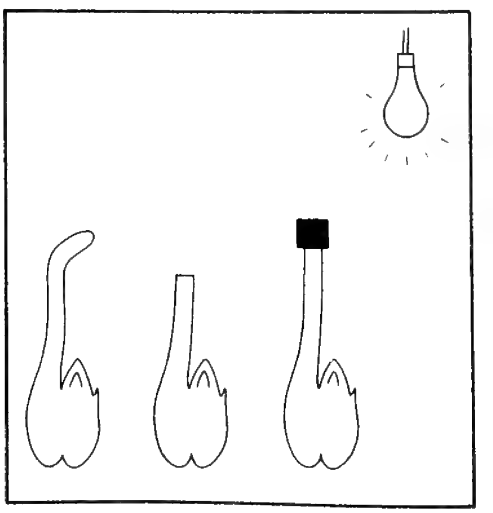


Fig. 1. Diagram of young oat seedlings showing Darwin's experiment on the necessity of the tip for bending and light perception.

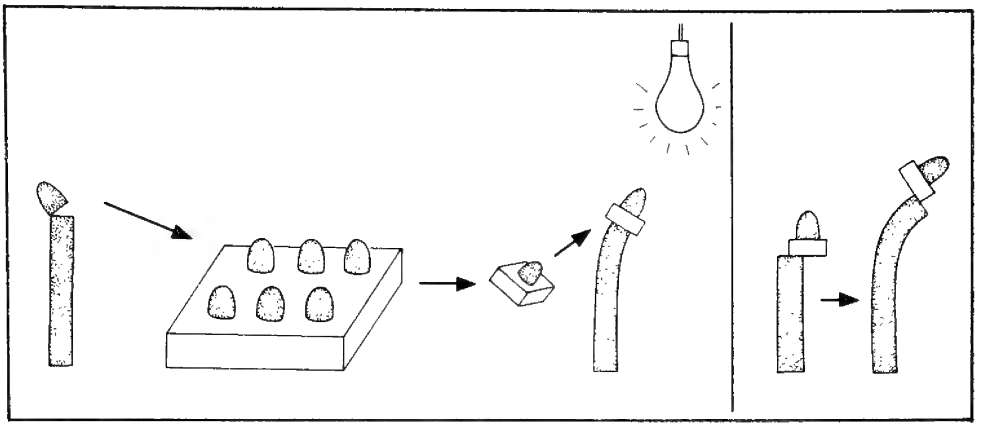


Fig. 2. Diagrams of Went's early experiments on the demonstration of a chemical control of bending reactions.

moved. Furthermore, the sheath would not bend when the tip was so covered as to exclude light, even when the rest of the plant was illuminated. Darwin concluded that there must be some chemical formed in the tip of the plant which moves down the plant to control or to regulate the differential cell elongation that results in bending. Many other plants are now known to show the same reactions, and so the concept developed that this chemical control mechanism was likely to be universal among plants.

Late in the nineteenth century and early in the twentieth, plant scientists attempted to learn more about the chemical basis for phototropic bending. They ground up plants, soaked the tissues in alcohol or water, and applied the resulting extracts to decapitated plants. A few of the extracts seemed to substitute for the missing stem tips, permitting the plants to bend naturally toward light. This provided additional evidence that the factor regulating phototropic bending was a chemical. In the 1920's, Dr. Frits Went set out to isolate this chemical. He cut off literally thousands of coleoptile tips of oat seedlings and placed them upright on an agar jelly. The cell-elongating chemical moved downward from the plant cells into the agar and could then be tested for its activity simply by placing a bit of agar back onto the stump of the coleoptile. Dr. Went found that if the agar block was placed off center, the plant would bend even in darkness.

Chemical techniques were inadequate at that time to permit purification of the cell-elongating substance; the compound was not isolated, purified, and characterized chemically until the 1930's. It turned out to be a relatively simple organic (carbon-containing) molecule called indoleacetic acid—dubbed IAA. Because of its growth-stimulating effects, it was called *auxin* (from the Greek *auxein* meaning *to increase*). IAA was eventually synthesized in laboratories and is now available in any quantity from large chemical companies.

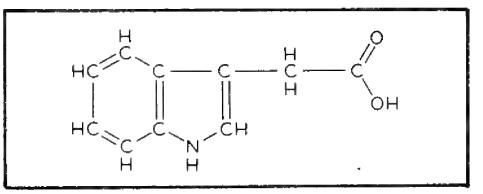


Fig. 3. Chemical formula of indoleacetic acid (IAA), the major plant auxin.

Fig. 4. Phototropic bending of a coleus plant.

Naturally, auxin was examined to see if it might be the chemical regulator of other growth processes in plants. When a plant such as coleus is laid on its side the stem bends up so the tip is again vertical; removal of the tip of the plant results in the stem's failure to bend. Similarly, the roots of the horizontal plant bend down, and removal of the root tip prevents root bending. The analogy of this geotropic (response to gravity) bending to phototropic bending was obvious, and experiments showed that the more rapid elongation of cells on one side, resulting in geotropic response, could be controlled by applications of auxin.

With IAA readily available, many plant scientists became interested in learning whether auxin was involved in the regulation of many different plant processes. The number of scientific reports on one or another phase of auxin effects on plants increased greatly and shows little sign of abating. Auxin is known to affect most, if not all, cell elongation in roots, stems, leaves, and flowers. It is one of the internal factors that regulate cell division in the plant, and it plays a role in the complex processes of differentiation. Refined techniques show that other biochemical processes also involve IAA.

Auxins (there are several closely related compounds) are produced by young, growing cells in the plant. Shoot and root tips, composed of rapidly dividing cells, are the primary sources; young leaves, floral parts, and buds are secondary sources. The generative layer of cells (the cambium) in plant stems also produces auxin. Auxins move in the plant from the places where they are produced to other parts of the plant. For unknown reasons, auxin movement is controlled in such a way that it moves primarily downward in the stem and upward in the root. Thus, higher concentrations are found in and near growing parts, with lower concentrations away from them. This gradient in auxin concentration may be partly responsible for the easily observed gradients in growth—young, apical parts of stems grow faster than older parts do. As we learn more about auxins, we find that this sim-

ple picture is probably not completely true, but it is sufficiently close to the truth to allow us to formulate a basis for the actions of auxins in growth.

Not much can be said yet about the biochemistry of auxin action; we really do not know exactly how it works on plant cells. Probably as many theories on the mode of action of auxin exist as there are plant physiologists—some physiologists even hold more than one theory. Recent research indicates that the auxins are intimately related to the complex hereditary material, the nucleic acids. One idea is that auxins, together with the genes and the other nucleic acids, control and regulate the synthesis of enzymes in a cell which, in turn, control the vital processes of growth, development, respiration, and synthesis of cell constituents.

Plant scientists realize that their knowledge of just which processes are influenced by auxins is far from complete. Most of the gross manifestations of auxin action—cell division, enlargements, etc.—have been studied; the more subtle changes at the biochemical level are now being examined with modern research tools. Even with our limited and incomplete view, the effects of auxins on plant processes are of horticultural interest.

Apical Dominance

Although auxins normally affect cell elongation and cell division, high auxinic concentrations can suppress these processes. Root tips, for example, make more auxin than is needed for root growth and, in many plants, artificial reduction in auxin will permit faster growth of roots. Buds, which produce their own auxin, are prevented from growing into shoots by application of auxins.

Branch or side-shoot development is controlled by auxin, too. A young tomato or bean plant has only one stem. The small buds at the leaf-stem junction (the axil of the stem) remain small for some time. This repression of axillary bud development occurs primarily because of the movement of auxins down from the stem tip (the apex of the plant) into the buds, which raises the concentration of auxin in the buds to inhibitory levels. The apex, or tip, is said to dominate the plant, hence "apical dominance." As the plant continues to grow in length, the apical source of auxin becomes farther and farther away from the buds, the concentration of auxin in buds drops, and some of the buds will develop. In coleus, for example, the side shoots commonly develop first near the base of the plant. To stimulate the development of these axillary buds, a standard horticultural practice is to remove the growing tip of the plant, thus reducing the supply of auxin and permitting the growth of the buds. The technique of pinching back, used on chrysanthemums and many other plants, results in the development of buds into shoots and the formation of a bushy plant.

Fig. 5. Young bean plants cut off just above the primary leaves. Plant on left was untreated; plant on right was treated with auxin.

The bud-inhibiting property of high concentrations of auxin is utilized by potato shippers who spray the tubers with auxin to prevent sprouting during storage. Single-stemmed plants can be maintained as single stems or prevented from becoming branched and bushy by treatments with auxin. Also, the auxin-producing apex at the root tip of a plant prevents the development of side roots—the commercial nurseryman root-prunes his superior planting stock to permit the development of side roots to get sturdy, well-rooted plants. The bonsai enthusiast cuts back the roots of his tortured starvelings every few years to limit the amount of root tissue capable of water and nutrient absorption, and reaps the benefit of well-rooted plants.

Rooting and Grafting

Serious gardeners do most of their own vegetative propagation by rooting of cuttings, and many advanced practitioners do their own grafting. In physiological terms, there is considerable similarity between these two activities. For roots to form, cells at the base of the cutting must first form a callus; the roots then develop from the cells of the callus. In grafting, a callus is formed from cells of both the stock and the scion. The

Fig. 6. Young coleus plants treated (left to right) with increasing concentrations of auxin prior to 7 days in a rooting bed.

successful graft union involves the blending of these calluses and the establishment of vessel connections in the graft. Another feature common to propagation by cutting or grafting is the requirement that a bud be present on the cutting or on the scion. Research by scientists and by horticulturists shows that the bud serves as a source of auxin which, moving down the stem, stimulates the cell division in those cells (usually the cambial or generative layer) that develop into the callus. Auxin serves here as a stimulant for cell division.

Obviously, many other factors are involved in the successful "take" of a cutting or of a graft union. Nutrition, humidity, temperature, light, and the callusing capacity of the plant at different times of the year must all be considered. Yet, even if all of these factors are ideal, the cell division that results in a callus will not occur without auxin. In many plants, the auxins present in the bud, leaves, or stem are inadequate for rapid callus and root formation and the whole process can be speeded up considerably by supplying additional auxin. Usually the auxins are supplied in the form of a convenient powder or liquid dip. The powder form contains several auxins mixed with talcum powder to permit easy handling and to retain long contact with the plant tissue.

Flowering

The internal processes that control the initiation and development of flowers are of great theoretical and practical importance and, in spite of a tremendous amount of research, are still imperfectly understood. Day length, quality and quantity of illumination, temperature, nutrition, and many other factors are certainly involved, but there is also a plant hormone interaction. Just what this hormonal action is, and how it is related to the other factors, is still unclear. In many plants, the evidence suggests that auxins play a negative role, that is, the presence of auxin suppresses flower formation. In other plants, addition of auxins stimulates flower formation. In Hawaii, for example, it is economically desirable for all the pineapples in a crop to mature at the same time. Normally this does not occur, but plant physiologists at the Pineapple Research Institute and the University of Hawaii found that if a solution of a synthetic auxin (more about these substances later) is simply poured into the center of the plant, the date of flowering and the time of the maturation of the fruit can be predicted accurately. Auxin applications to horticultural plants have rarely been made, and this area of hormone physiology is ripe for study.

Fig. 7. Young coleus plants — left, the intact control plant; middle plant had leaf blades removed and petiole stump smeared with auxin; plant on right had petiole stump untreated.

Seed-free Fruits

Pollination and fertilization are, under natural conditions, not only the usual prerequisites for the formation of the embryonic plant which forms the next generation, but they are involved in the development of those cells and tissues that form the fruit. Since the developing embryo and its associated nutritive tissues, the endosperm, are known to be excellent sources of auxin, it seemed reasonable that auxin was one of the factors that stimulated fruit development. By spraying some plants with auxin at the time the flowers are developing, but before pollination, it has been possible to produce fruit without seeds. Greenhouse-grown tomatoes for some reason are difficult to pollinate, and auxin-sprayed, seedless fruit has, in some European countries, become the accepted market form. Seedless watermelons, peppers, and other crops of high economic value are being marketed here and abroad. Insofar as I can tell, color and flavor are excellent.

Leaf Fall

Growing leaves rarely fall from a plant unless the leaf is injured or until the leaf begins to decline. Careful observation will show that the leaf does not simply break away from the stem; a special zone of cells at the base of the petiole forms a corky, water-impervious layer which then separates, allowing the leaf and its petiole to fall. During the growing season, auxins formed in the leaf blade move down the petiole and maintain the cells in the abscission layer in a healthy, growing condition. When the auxin is reduced by injury or senescence, the abscission cells develop the corky layer, cutting off water supply, and the leaf falls. If a paste of auxin is applied to the end of the cut leaf stalk, replacing the natural source (the leaf blade), the petioles will remain firmly attached to the stem for long periods of time.

Under horticultural or agricultural conditions, reductions and accelerations of leaf fall may both be of importance. No Christmas is complete without the dark green foliage and bright red berries of holly. Much of the holly that appears on the East Coast in December is grown on the West Coast, cut in late fall, and shipped across the country for storage and sale. Auxin supplied to the cut twigs reduces berry and leaf drop to negligible levels. Applications of auxin can hold foliage and blossoms of some cut flowers, and may be used to maintain plants subjected to the generally unsatisfactory environment of a flower show.

Flower and Fruit Volume

Auxin also controls the number of flowers and fruits on apple trees. Growers wish to maintain the flowers for a sufficiently long period of time in the spring to permit complete pol-

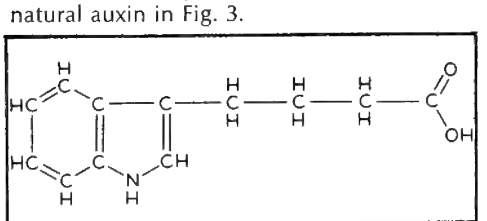
lination, for which they use auxin incorporated into insect sprays. Later in the season, but before the fruit has matured, auxin sprays prevent fruit drop and increase the yield. Even later, when the fruit is to be picked, judicious applications of compounds that *oppose* the action of auxins will facilitate harvesting. The successful introduction of mechanical cotton pickers into the South depended upon the development of compounds that could be sprayed on the maturing plants to make the leaves drop before cotton harvest.

Weed Killers

We have seen that under some circumstances auxins can stimulate growth and development, and under other circumstances the same compounds can repress growth. In part, the differences in plant response depend on the stage of a plant's development, but the concentration and the chemical form are important considerations, too. To study these factors, biologists persuaded chemists to prepare synthetic compounds not existing in nature, but with auxin-like effects.

Some of these compounds are very similar in structure to natural indoleacetic acid (IAA). Indolebutyric acid, for example, differs from IAA only in the length of the carbon side chain. Indolebutyric acid is one of the components in the previously mentioned powders used to aid rooting of cuttings. Other synthetic auxins such as the naphtho-auxins were developed so we would have an auxin-active compound that is not destroyed by enzymes formed by the plant. The phenoxy-auxins, of which 2,4-dichlorophenoxyacetic acid (2,4-D) is the best known, were developed for the same purposes. They are stable, not destroyed by plant enzymes, and are active in low concentrations. For rather unpleasant reasons, 2,4-D was first studied extensively during World War II by the Chemical Warfare branch of the U. S. Army. When applied to plants, 2,4-D raises the total auxin level to toxic concentrations; leaf drop, twisted growth, and metabolic changes occur and the plant dies. Interestingly, 2,4-D and allied compounds (2,4,5-T) are most effective on broad-leaved plants and are less effective on grasses and other narrow-leaved plants. This differential effect is the basis for using the phenoxy-auxins on lawns: dandelions and plantains are killed and the grass is not affected. Spraying of roadsides with 2,4-D has reduced the necessity for frequent mowing, but the concommitant enhanced growth of crabgrass and other monocots has simply altered the weed control problem instead of solving it. Other weed killers, usually not auxins, have been developed for the grasses. An unanticipated consequence of weed-killer applications to both monocots and dicots is the development of virtually bare roadsides that cannot support birds or animals and that erode quickly. The ecology of an area must be considered seriously before plant-growth regulators are used.

Fig. 8. Chemical formula of the synthetic auxin, indolebutyric acid. Note similarity to natural auxin in Fig. 3.



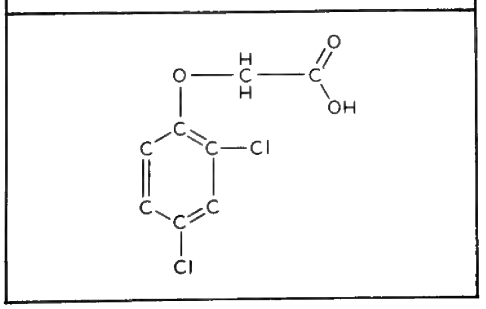


Fig. 9. Chemical formula of the synthetic auxin, 2,4-dichlorophenoyacetic acid. It is quite different from the indole auxins but there are some similarities.

The gardener and the agriculturist should be aware that spraying with weed killers can present legal problems. Sprayed substances can be carried on the wind for several miles and can injure plants far distant from the place of initial application. Indiscriminant spraying of your lawn can damage your neighbor's rose bushes; defoliant spraying of cotton has resulted in loss of a tomato crop ten miles away.

Anti-auxins

At several places above, we have mentioned compounds that inhibit the effectiveness of auxins. These compounds, called anti-auxins, were developed to permit plant physiologists to probe the details of how auxins actually work inside cells. The theoretical basis for anti-auxins was developed by biochemists. If the chemical structure of a biologically active compound is known, and something is known about where and how it functions in a cell, it is possible to devise another compound similar in structure to the natural one. This "almost identical but not quite" compound can fit into the mechanisms of a cell, but since it is slightly different, it can jam the metabolic machinery at some key place—it is the wrong-sized bolt. By jamming or blocking the cell processes, the scientist can study the effects on and consequences of a process. Anti-compounds are used in the treatment of disease: the sulfa drugs are anti-compounds for a required vitamin and some anti-leukemia drugs are anti-nucleic acid compounds.

A few anti-auxins are coming into horticultural and agricultural use as defoliants, growth repressants, and flower-formation activators. Anti-auxins may have horticultural use in inducing the bud development that results in branching.

Other Chemicals in Plants

We have seen that an auxin is a natural cell constituent or a synthetic mimic of a natural compound. Depending on the concentration and on the stage of growth and condition of the plant, auxins affect the control of the sequence of cell divisions, enlargements, and differentiations that result in a "normal-looking" plant. Modifying the concentration of synthetic auxins and anti-auxins can result in desirable alterations in plant development.

Nevertheless, in the late 1940's and early 1950's plant physiologists were vaguely troubled. It seemed unlikely that a single compound, IAA, could be solely responsible for the manifold effects ascribed to it. After all, repression and release of bud growth, leaf drop, cell division in the meristems of plants and cell enlargement further down the stem, phototropism, chemical and physical changes in cell walls, pigment production, and many other responses

could not be wholly explained by assuming that there were differences in auxin concentration. Living systems are seldom that simple, and many examples of chemical and physical checks and balances were known in respiration, photosynthesis, and other vital processes.

Physiologists also knew that plants produced other compounds which, when isolated and purified, had pronounced effects on responses of plants. These compounds did not have auxin-like chemical structures, nor did they show typical auxin-like effects in standardized test reactions. Maybe these other chemicals were involved in growth.

The Gibberellins

The breakthrough in solving the question of the possible existence of hormones other than auxin was, in fact, already in the scientific literature, but it had been almost completely ignored (isn't it wonderful how effective hindsight is?). In Japan a fungous disease of rice caused plants to grow excessively tall and spindly. The English translation of *bakanae*, the name for this condition, is "the foolish seedling disease." Prior to World War II, plant pathologists studying this disease had interested several Japanese chemists in the problem, and a chemical produced by the fungus that caused the excessive elongation of the rice plant was isolated and characterized. The Japanese chemists named the chemical gibberellic acid after the producing fungus, *Gibberella fuji-kuroi*. The 1942 clamp-down on scientific exchange prevented Western scientists from learning of this important research.

When the war ended, teams of American and European scientists went to Japan to learn what had been done during the war, and Japanese scientists visited the West. The work in Japan was repeated and confirmed, and plant physiologists began to wonder if gibberellin might be one of the other compounds involved in hormonal regulation of normal plant growth. In general, the research showed that gibberellins (abbreviated GA) were powerful cell-elongation factors—thus accounting for the foolish seedlings. Gibberellins did not, by themselves, have too much effect on cell division, and were cell-differentiation factors only in special situations.

Since GA did have profound effects on higher plants, plant scientists wanted to know if plants produced it naturally. Once the techniques of isolation, purification, chemical and biological estimation and associated problems were worked out, the scientists found that plants produced gibberellins. Not unexpectedly, the gibberellins produced by plants differed chemically from each other and showed some differences in activity in standardized tests. Some particularly well-studied plants produced several GA's that seem to have specialized effects. Other investigation showed that natural GA-like compounds are formed or activated only during particular stages in the life cycle of the plant.

The excitement generated among plant scientists by the reports that a new type of growth regulator occurred generally in plants led to the demand that the gibberellins become available for research purposes. Several large drug companies, having considerable experience in producing fermentation products (such as penicillin) from fungi, undertook the large-scale production of gibberellins. These companies have usually made adequate supplies of the pure material available without charge to professional scientists, thus permitting extensive testing in the laboratory and in field and garden plots.

From the work on rice and a few other plants, it was clear that GA was a natural growth regulator that stimulated cell elongation. Could this explain some of the growth responses of plants that were inexplicable in terms of the known effects of auxins on cells? Plant geneticists and physiologists wondered whether naturally dwarfed plants were short because they did not make enough GA. The differences in size in peas, where bush and telephone varieties are strikingly different in stem length, proved to be due to an altered production of GA by the bush varieties. They were deficient in those genetic factors involved in controlling the production of GA. Light sprayings with the gibberellins isolated from fungi will convert a dwarf bush form of pea into what looks like a tall, or telephone, variety. To maintain the telephone form, it is necessary to supply GA at intervals throughout the life of the plant.

Peach seeds provided the next link in the chain of evidence that GA was an important growth regulator in natural situations. If a peach seed is planted without any period of cold dormancy, the resulting seedling will be small with short shoots. The seedling will elongate almost normally if GA is supplied, but its continued elongation over a period of years requires regular applications of GA. If, on the other hand, the peach seed is chilled for a six- to eight-week period before germination, the resulting seedling will grow well and show no GA requirement. It would seem that chilling before germination (at least in peach) is necessary to set the GA-producing machinery into permanent operation.

To get good leaf and flower development of tulips, daffodils, crocus,

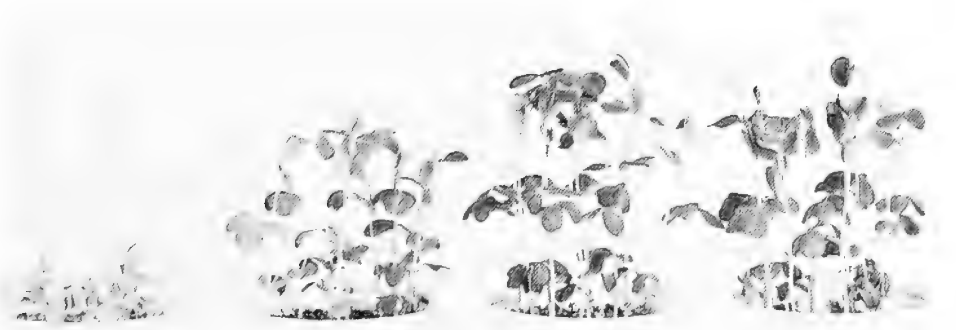


Fig. 10. Growth habit of dwarf (two left pots) and tall (two right pots) peas. One pot in each set was sprayed with gibberellic acid. The sprayed dwarf pea responded strikingly but the sprayed tall pea did not respond.

and other spring-flowering bulbs, it is common horticultural practice to plant the bulbs in the fall and allow them to overwinter in the ground. Winter chilling is also necessary for the development of leaf and flower buds on many trees. In upper New York State the apple crop is usually poor after a very mild winter. This chilling procedure, called vernalization (a translation of the Russian term, jarovization, or "making like spring") can be partly or fully replaced by treatment with GA. The facts are not all available yet, but it seems probable that the situation is exactly like that found in peach seeds. Pussy willow and many other twigs cut and brought indoors usually develop better if they have previously been winter chilled or treated with GA. On an agricultural level, vernalization or GA can stimulate winter wheat so that it will develop and mature quickly the following year. Such knowledge has resulted in the exploitation of Siberia and the northern regions of Canada for growing wheat and other cereal grains.

Recently, researchers have tried to discover why GA does speed up germination and growth of cereal grains. The young barley embryo is absolutely dependent for its growth and germination on the stored starch in the endosperm of the grain. But, in order for the starch to be used by the embryo, it must be converted into soluble sugars that can move from the endosperm into the embryo. In the dry grain, the enzyme (amylase) responsible for the starch-sugar conversion is almost absent, but as water is taken up, a GA from the embryo moves to a special layer of cells (the aleurone) activating the production of starch-hydrolyzing amylase. This process is useful to the brewing industry, where barley malt is utilized as the source of amylase in the conversion of starch to the sugars made into alcohol by yeast. In fact, it was noticed in 1955 that better beer production resulted from the addition of GA to the malt, but the enzyme-synthesis explanation was not worked out for another five years.

On the agricultural front, the importance of GA was soon recognized and its cell-elongating and cell-enlarging properties were exploited. Celery growers now use GA to get longer leaf stalks and hemp growers increase the length of sisal fibers by spraying the growing plants. It is possible that similar treatment can increase the length of linen fibers. GA stimulates the sprouting of seed pieces of potato. In the white Thompson's seedless grape, GA is formed in the vegetative parts of the vines and moves into the fruit at an early stage of development, causing the cells to enlarge. Larger juicier grapes can be formed when they are sprayed with GA—an advantage when they

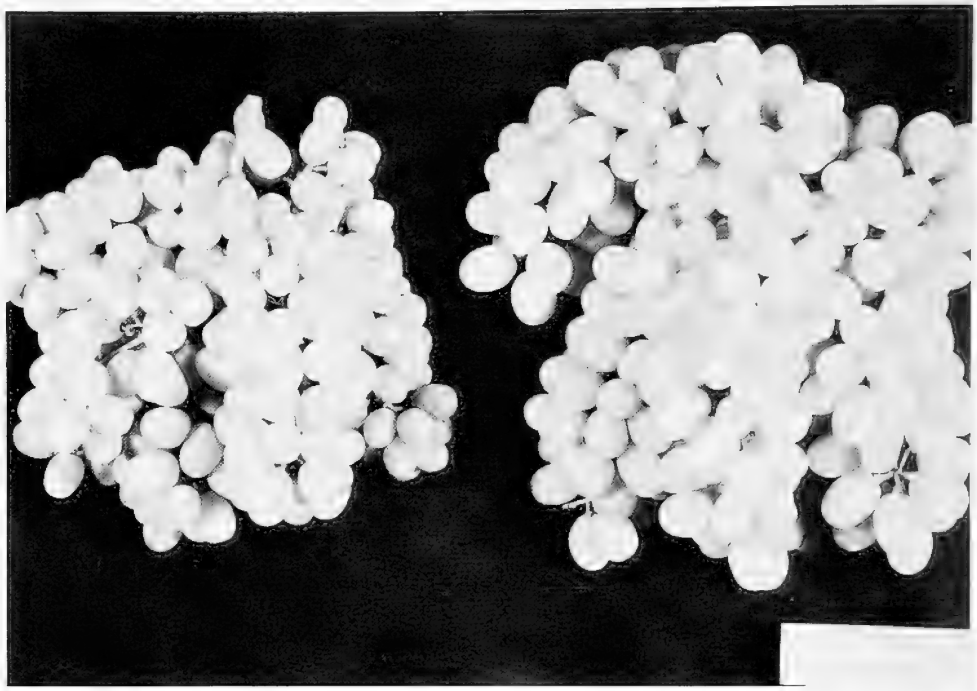


Fig. 11. Effect of gibberellic acid on the size and shape of Thompson's seedless grapes — sprayed cluster is on the right. (Photograph courtesy of Prof. Robert J. Weaver, University of California, Davis.)

Fig. 12. The effect of a dwarfing compound, Phosphon D, on the development of young bean seedlings. (Photograph by Walter Singer, courtesy of Prof. H. H. Clum.)

are used on the table or for making a light white wine. In Australia, where sheep graze in the winter, the growth of forage grasses can be stimulated by spraying with GA. To date, this has not been tested on lawns, but GA may be a valuable new tool in this country.

Seed germination, too, seems to be affected by GA. Certain seeds, such as those of lettuce, will not germinate in darkness, but require small amounts of red light. GA can replace the red light. The expansion of young leaves requires red light and this requirement can also be partly filled by GA. The light-controlled induction of flowering of long-day plants and the elongation of the rosette of such long-day plants (henbane, etc.) can be accomplished under spring and fall conditions by spraying the plants with GA. Some biennials can be brought into flower in one year with GA—an important consideration in plant-breeding programs and potentially important to both the home gardener and the commercial grower. The range of light-mimicking effects of GA continues to amaze plant physiologists, and this aspect of growth-regulator research is still active.

If natural, internally formed GA is capable of influencing elongation of plants, it should be possible to find compounds that serve as anti-GA factors, as is true of auxins and anti-auxins, or to find compounds that will prevent the forming of GA by the plant. This should result in controlled dwarfing, a horticulturally desirable condition under certain circumstances. Unfortunately, no good anti-GA has been found, but very effective anti-GA-production compounds have been developed. Two of these, Cyclocel and Phosphon D, seem to cause dwarfing by preventing the production by the plant of GA. These two compounds are now available commercially—even in the convenient aerosol can—and are used to produce shortened stems in chrysanthemums, Easter lilies, and other flowering annuals. The range of plants that can be dwarfed is not completely known, and the home grower can contribute to the research of the professional scientist. The purist may wince, but it is possible to use GA and the anti-GA-production compounds to control the development of bonsai and rock-garden plants. Until we know more about the effects of the dwarfing compounds on humans, they should not be used on food plants.

We have seen that the gibberellins form a group of plant-growth substances completely different from the auxins. Gibberellins are produced by many plants, and have some effects similar to those of auxins and other effects that are apparently unrelated to those produced by auxins. The possibility of interactions between auxins and GA has been investigated in very carefully controlled experiments. Indeed, there are interactions, some of them very complex. Apparently both auxin and GA are required for normal cell enlargement and division. GA and auxin may cooperate in producing an effect, they may antagonize the action of each other, and they may neutralize the effects of each other. By controlling the ratio of auxin and GA, we can learn more about cell growth and, eventually, about the development of plants. This knowledge will inevitably be translated into horticultural and agricultural practice.

Gibberellins are commercially available in spray cans. It is impossible to give firm rules for their use at this time. Certainly, many plants respond to GA by increasing their stem length and this alone makes GA worth testing under garden conditions. Heed three major cautions, however: (1) The gas propellant in the spray can is capable of damaging foliage; be sure to hold the spray-can nozzle at least a foot away from the plant, to allow the propellant to evaporate before it strikes the plant. (2) GA causes dramatic growth responses, so the inorganic nutrient supply may be depleted; be sure that GA-treated plants are well fertilized. (3) Remember that if a little is good, a lot may not be good; use GA judiciously.

Abscissin and Dormin

One stray part of the hormone-balance problem came into focus very recently. For many years, plant scientists had been studying the problem of dormancy in tree buds and in the sprouting of potatoes. It was determined by one group of scientists that the rest period was initiated by the production within the plant of a compound that was called the beta-inhibitor. Another group of scientists found that a compound present in young cotton fruits affected the dropping of the leaves. Other reports on inhibitors of seed germination also seemed to be unrelated to the story of the gibberellins—so unrelated that each of the compounds was given a different name, i.e., inhibitor beta, abscissin, anti-bud break, or dormin. Soon botanists and chemists in the United States, in Wales, in Japan, and in Germany found that all of these compounds were the same, and the plethora of names has been reduced to either abscissin (when leaf fall is under consideration) or dormin (when cessation of growth is being studied). We still are not quite sure whether dormin acts on the metabolism of the auxin hormones by modifying the action of gibberellic acid or by poorly understood alterations in the nucleic acids. In some cases, the effects of dormin can be reversed by auxin, in other cases by gibberellins, and in still other cases by both or by neither. Abscissin has been made chemically and its use as a defoliant is being explored. Scientists also hope to develop dormin-like or anti-dormin compounds to control the rest period of buds at will.

The Kinins

Although the auxins and the gibberellins accounted for a number of growth responses in plants, plant physiologists felt that other chemicals must also be involved in plant growth. Again, part of the answer came from an apparently unrelated set of research reports. Many years ago, a plant geneticist tried to grow embryos of *Datura* in sterile test tube culture to get plants for his research. The embryos grew for a short time, then died. Someone suggested that the embryos might grow better and longer if he added extracts of plants, because it was known that embryos "feed" off the parent nutrients. Among the substances tested was coconut milk; the embryos grew very

well indeed, and the geneticist was able to finish his research.

The report languished in the scientific literature for many years; occasionally a paper appeared noting that coconut milk was a good additive for the *in vitro* cultivation of many different kinds of plant tissue. The scientists in one American university laboratory decided to find out just what was in the coconut milk; this required hundreds of gallons of coconut milk, extensive chemical equipment, and some kind of assay. (Whenever a new biologically active substance is to be isolated, an assay—quantitative test—is necessary in order to know which fraction of the source material contains the desired active substance. A biological assay is based on the effect of the compound on some particular organism; carrots were used for the assay of the active material from coconut milk.)

With the carrot-tissue assay, coconut milk was found to contain one or more substances that could make cells divide rapidly. Similar substances were present in young banana fruits, in horse-chestnut seeds, in corn, and in plant tumors. The material was quite active, but the scientists noticed than an auxin had to be present to start the cells growing—even though the auxin alone was not particularly effective.

Shortly after the work on coconut milk had begun to yield interesting results, scientists at the University of Wisconsin tried to grow pieces of the pith of tobacco plants. The pith of tobacco is a most useful test system. The cells are very uniform, the pith can be obtained in fairly large pieces, and growth is readily apparent. The Wisconsin scientists found that one particular bottle of a dried extract of yeast contained a compound that, in the presence of auxin, caused rapid proliferation of the pith cells. Attempts to repeat this research with fresh yeast extract from the same company yielded poor results. This suggested that the active unknown compound might not normally be present in yeast extract but might be formed from some other compound with time. This proved to be true. Heating the yeast extract hastened the formation of this cell-division factor. Long and very painstaking chemical and biological research finally resulted, in the late 1950's, in the isolation of a single compound with cell-division stimulating activity. The chemical structure was determined and the compound was called *kinetin* (from the Greek *kinesis,* meaning *to grow*). Coconut milk, too, contains one or more kinins that are not chemically identical to kinetin. Since the structure of the kinins is completely different from that of auxins or of gibberellins, plant physiologists obviously have a third group of compounds to fit into the growth-regulating picture.

In general, the kinins are most effective with auxins in cooperative growth regulation. At least part of the effectiveness of auxin in causing cell division—a prerequisite to the initiation of buds or roots—is due to the presence of kinins in the plant. Compounds related to kinetin—such as the purine, adenine—had long been known to act as root-initiating compounds and this fact now fell into place. Some laboratories found that kinins might be operating in flower induction, suggesting that there is cooperation between gibberellin and kinetin and possibly with auxins, too. Work at The New York Botanical Garden has shown that kinetin, but not gibberellin, was the amylase stimulant for starch digestion in bean stems, whereas gibberellin was the enzyme activator in cereal grains. It is possible that both are required, with gibberellin being in sub-optimum supply in barley and kinetin being limiting for bean stems.

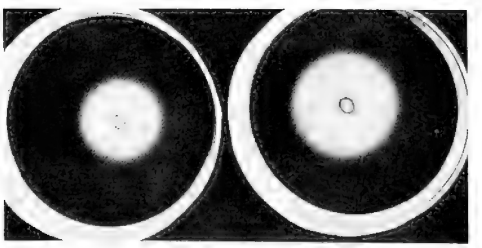


Fig. 13. Activation by kinetin of the starch-destroying enzyme from slices of bean stem. Pieces of stem are held in kinetin solution and then placed in petri dishes on a starch jelly. The diameter of the zone of hydrolysis (shown as a white circle) is a measure of the activity of the enzyme. Tissue without kinetin on the left, tissue with kinetin on the right. (Photograph by Walter Singer, courtesy of Prof. H. H. Clum.)

Knowledge of the kinins is insufficient to permit the development of horticultural formulations. This does not mean that the kinins will stay in the laboratory; usually, practical applications follow pure research.

The Lipid Factor

The scientists' feeling of incompleteness apparently was not eased by the kinetin work. A scientist at Yale University decided to see if auxins, kinins, and gibberellins were the whole story. He marked the young stems of pea plants with a series of dots so that he could determine where elongation occurred. By careful measurements, he was able to calculate the growth capacity of the stems in terms of the portion growing and the rate of growth. Then he cut pea stems into uniform lengths and added appropriate concentrations of all known growth factors—sugar, inorganic salts, etc. He found that even with all of these additives, the pea-stem segments still did not grow as rapidly as did the same segments when still part of the whole plant.

Again, a chemical and biological test system was set up which revealed that some compound from pea plants that was soluble in ether would improve the growth of pea-stem fragments. The solubility in ether suggested that the unknown factor was likely to be a lipid (fatty substance) and, upon purification, it proved to be any of several fairly common chemicals called unsaturated fatty acids. Work in other laboratories showed that the lipid factor was active in a variety of plants, and it now looks as if it is of general importance. At this time, we know that the lipid factor interacts with auxins and gibberellins but not with the kinins. We do not know how it acts to assist or trigger cell elongation, or whether it is produced in one part of the plant and moves to another part.

Ethylene

Early in this century, farmers in southern California began to grow citrus trees. They found it economically efficient to pick all of the lemons in a grove at the same time, even if

some of the fruits were unripe. The unripe lemons were placed in a small room with a kerosene stove, and within a few days they became a rich lemony color and the ripened fruit could be shipped to market. Over the years, lemon growing and artificial ripening ("color added") became an important part of the economy of the region.

One enterprising farmer decided to use an electric space heater in place of the smelly kerosene stove which needed constant tending. He was shocked to find that his lemons stayed green and, of course, he lost considerable money. Instead of just returning to the use of kerosene, he investigated, and found that kerosene that is burned in a closed (oxygen-poor) atmosphere emits a gas. It was not the heat that caused the lemons to ripen, but this gas.

In 1924 a U. S. Department of Agriculture scientist isolated the gas, found it to be extremely effective in ripening citrus, and determined that it was the common, simple chemical, ethylene. Citrus growers soon converted to gas-tight rooms that could be filled with exactly the right concentration of ethylene. Lemons and other citrus fruits ripened rapidly and uniformly, and the process is now standard in the industry.

A few years later, physiologists and biochemists at the University of California, Los Angeles, were studying the metabolism of avocado fruits as they ripened. Treatment of the fruits with ethylene speeded up the ripening process and caused profound changes in the metabolism of the cells; and the ripening process caused the plant to begin to make more ethylene, which further accelerated ripening and the synthesis of more ethylene. This is why the paper wrapper is left on unripe pears. The fruit produces a small amount of ethylene which is prevented from wafting away by the wrapper; this stimulates more ethylene production and ripening is hastened.

At about the same time, two scientists at The Boyce Thompson Institute, Yonkers, New York, were studying the effects of ethylene on young tomato plants. They found that just traces of ethylene gas caused the branches to bend sharply downward —a phenomenon called epinasty, previously observed following treatment of the branch with auxins. Since epinasty involves the differential elongation of those cells on the upper part of the branch, it began to look as if ethylene might be a cell-elongation factor similar to auxin.

The observations and conclusions on epinasty suggested that the question of auxin effects on cells should be re-examined in terms of the possible participation of ethylene. This work is current and only tentative conclusions can be drawn. One group of scientists inclines to the view that all or most of the reported effects of auxin are due to ethylene production that resulted from application of auxin. Thus, auxin would be a trigger for ethylene which, in turn, is the actual growth stimulant. More conservative scientists feel that although there is a close relation between auxin and ethylene, the exact relation between the chemicals is uncertain. Still other scientists think that ethylene is another part of the complex of growth factors that act on plant cells. This controversy will probably be settled fairly soon—such honest differences are common in science—and it is likely that some intermediate position will be in accordance with the facts.

In any case, ethylene certainly acts like a plant-growth regulator and has proved to be of considerable importance in agriculture. Because of its volatility, it probably will not play an important role in home and garden cultivation of plants except as a possible danger. Ethylene is found in significant quantities in artificial illuminating gas, although it is absent from or minimal in natural gas. When artificial gas was used in homes, it was difficult to grow normal looking plants. Gas leaks, incompletely burned gas, and extinguished pilot lights allowed an accumulation of enough ethylene to cause twisted plant stems, loss of leaves and flower buds, and poor root growth. Leaks in the mains carrying artificial illuminating gas permitted enough ethylene to accumulate around the roots of shade trees to kill them. Work at The New York Botanical Garden has shown that natural gas does not produce these harmful effects.

Other Growth Factors

There is a hazy no-man's-land where it becomes impossible to determine exactly what *is* a plant-growth substance. Usually, we eliminate inorganic ions, bulk nutrients (sugars, amino acids), and chemicals needed by cells for enzyme action from listings of plant-growth substances. Nevertheless, the inorganic ion, cobalt, interacts with growth substances, can substitute for red light (as does gibberellin), and can profoundly alter patterns of growth and development. Normally, cobalt is not needed by most plants, although it is required by some bacteria. Yet, when cells are isolated from the rest of the plant, cobalt is frequently required for their development. Perhaps cobalt mimics some natural growth substance whose source was discarded when the tissue was taken from the plant. The same may be true for the inorganic nitrate ion; other special instances could also be cited.

The discovery of a new growth-regulating chemical requires a test subject that normally has a positive requirement for the substance. If the plant or plant part does not grow in the presence of a presumably adequate supply of all known chemicals, something else is required. This something else can be, as we have seen, one completely unknown group of compounds such as the kinins, or a compound known to chemists but not suspected of being required by plants (lipids), or even, as in the case of ethylene, a compound known to be required for processes apparently unrelated to growth. Today, many laboratories are working on growth-regulating compounds, trying to find new ones, re-investigating the known ones in the light of recent discoveries, or working out the details of how, where, and why a compound is active. Some of the results of this labor—and it is hard, painstaking, detailed work—have already reached the spray-can stage for home and garden application or the carload level for agricultural use. Look for them at your friendly seed and plant store. ■

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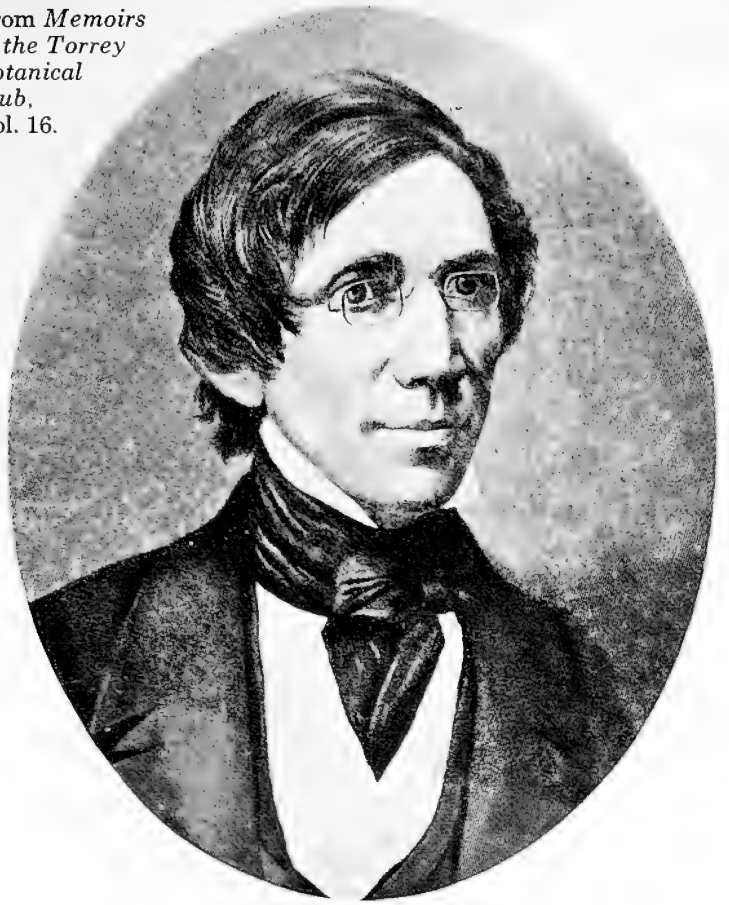
From *Memoirs of the Torrey Botanical Club*, Vol. 16.



John Torrey

August 15, 1796 March 10, 1873

This issue of the GARDEN JOURNAL is

Dedicated to the members of the Torrey Botanical Club—those gone, those here, those to come—on the occasion of the Club's 1967 celebration of its first hundred years.

We have selected documents and photographs that illustrate the Club's activities and the members' personalities for more than a century. Some of the documents appear in facsimile, some are reproduced directly from original copies but rearranged in format for reasons of space, others are reset in type because the originals are unsuited for exact reproduction. The facsimiles and other photographic reproductions are, we grant, not always easy to read. But the grace of the language is its own reward. The documents and old photographs were brought together with the assistance of John F. Reed, Curator of the Library of The New York Botanical Garden, and Dr. Annette Hervey. The skill of Walter Singer, Staff Photographer, in photographing the very old, faded pictures has made them look better than the originals.

You may be amused to know that the Torrey Botanical Club began 1886 with a cash balance of $2.29 and ended the year with $6.98—those staunch ladies and gentlemen were well acquainted with the problems we endure in 1967—but surely you will regard with respect the contributions to botany by the amateur and professional botanists who comprise the Club, and join our salute to them.

JOHN TORREY AND THE NEW YORK BOTANICAL GARDEN

By William C. Steere, Director
The New York Botanical Garden

The eminence of Dr. John Torrey is appropriately symbolized by a unique tree in Florida and a conspicuous mountain in Colorado that bear his name. Nearly a century after Torrey's death, *Torreya,* the tree, and Torrey's Peak still keep his name before us, and will continue to do so in perpetuity. Torrey's great stature as the pioneer and outstanding systematic botanist in America resulted not from burning ambition and a fiercely competitive spirit, but from an intense interest and curiosity, combined with enormous vitality and industry, as well as great natural talent. Today, Torrey's *Flora of New York State,* published in 1843, is still the only comprehensive treatment of the plants of our State. The naturalists of all the great expeditions of his time, exploring the Mexican boundary or seeking alternative feasible routes for railroads through the west, turned to him for identification of plants collected in those distant and then unknown places. Because of his cooperative and friendly attitude toward his botanical friends, colleagues and protégés, and his scrupulous honesty in giving them full credit for their discoveries, he was able to induce them to take part in the bourgeoning botanical exploration of North America, with which Dr. Torrey is so wholly identified through his numerous publications on western plants. His crowning achievement, of course, was his monumental work, *A Flora of North America,* published between 1838 and 1843 and authored jointly with his one-time student, Asa Gray. As the first major and comprehensive work on the plants of so large an area in the New World, these publications established John Torrey as the major American botanist of his time, as well as one of the great botanists of the world—a just reward for a shy but generous and dedicated person.

I shall make it my business here to relate the interesting historical circumstances and events which have made The New York Botanical Garden the institution with which John Torrey's name is associated today, something that never could have been predicted, yet which by hindsight appears almost inevitable!

Biographers of both men agree that young John Torrey came under the influence of Dr. David Hosack, a distinguished medical teacher and practitioner who was also one of the prominent botanists of his day. As a man of some means, Dr. Hosack founded the Elgin Botanic Garden at his own expense in 1801, taking for a prototype the Jardin des Plantes in Paris. This new botanic garden was an important attraction to notable botanists and medical men of the day, both Americans and foreign visitors. John Torrey, who began his study of plants as a boy, may well have taken specimens to the Elgin Botanic Garden for Hosack's advice on their identification, and it is equally possible that he may have audited Hosack's series of lectures on botany. The record shows that John Torrey's father, William Torrey, while an alderman on the Common Council of New York City, took a most generous attitude toward Dr. Hosack's obligation to pay rent on land that he had leased from the City for part of the Elgin Botanic Garden, so that William Torrey, too, had more than a casual interest in this institution. Eventually finding his public garden too expensive to maintain privately, Dr. Hosack decided to sell it to the State of New York, in 1811. Long after the sale of his botanic garden, Dr. Hosack eloquently defended the concept of and the need for a botanic garden in New York City—even though the State allowed his to fall into ruin. By coincidence, much of Dr. Hosack's library is today at The New York Botanical Garden, as well as a portrait given by his descendants.

John Torrey, then, was exposed early to the multiple benefits of a public botanic garden, not only from his own visits to the Elgin Botanic Garden, but also from continued close association with Dr. Hosack, first as his student at the College of Physicians and Surgeons (from which Torrey received his M.D. in 1818) and as his assistant in a course of botany in 1822. The impact of the Elgin Botanic Garden on John Torrey at an impressionable age became evident many years later. The Botanical Club of New York held a Torrey Festival in 1867—a supper to commemorate

(This report of The Torrey Festival, December 20, 1867, is reproduced from the original printing of the seven-page booklet, which probably was distributed to the guests who had attended the dinner.)

THE TORREY FESTIVAL.

THE Botanical Club of New York has been for some time engaged on a catalogue of the plants growing within thirty miles of New York City. A catalogue, embracing the same territory, was made in 1817, by Dr. John Torrey, and the Club celebrated the fiftieth anniversary of its completion by a supper at the Astor House, on the twentieth of December. Invitations were extended to those who had prominently identified themselves with American botany, and the club wishes us to say that they used all possible diligence to invite all interested, and if there were any omitted, it was from inadvertence. The day was unfortunately one of the most inclement of the year, and the impediments to travel prevented many from coming from abroad. Among the guests were Professor Gray and Dr. Pickering, of Cambridge; Professors Eaton and Brewer, of New Haven; Professors Porter and Green, of Easton, Pa.; Thomas P. James, of Philadelphia; S. T. Olney, of Providence; C. F. Austin, Closter, N. J.; S. B. Parsons, of Flushing; and I. Buchanan, of New York. All present were furnished with a button-hole sprig of *Torreya*, and after a short time spent in social intercourse, the company were seated at table, Prof. George Thurber presiding. After the substantials had been disposed of, Professor Thurber gave the following

ADDRESS.

For some occult reason I have been placed in a position where I am to speak for the Botanical Club of New York. It is indeed a pleasure to meet such a number of botanists, and my first duty is to express the thanks of the Club to those who have come from abroad at this inclement season to aid us in our festivities. The incentive to this genial gathering is so well understood, that any elaborate remarks are fortunately unnecessary. On December 22d, 1817, there was presented to the Lyceum of Natural History, "A Catalogue of Plants growing spontaneously within thirty miles of the city of New York." The Botanical Club, which comprises, so far as we are aware, all the working botanists of New York and its suburbs, has thought proper to mark the fiftieth anniversary of an event so interesting to local botanists, and the commencement of a career so important to botanical science, not only in America, but in the world.

Here I must correct an error of the printed invitations, which are made to say that this is the fiftieth anniversary of the publication of the catalogue. The title-page bears the date of 1819, and an explanatory advertisement says, "Although the following pages were reported as early as December 22d, 1817, unavoidable obstacles have delayed its publication until the present time." It is not the publication of the catalogue that we celebrate, but its completion and presentation to the body which requested it to be prepared. As the 22d day falls this year on the Sabbath, the nearest convenient day was chosen. There may be those who think it would have been more appropriate to regard the anniversary of publication, rather than that of its presentation. Such are assured that the Club will consider the subject in season for the centennial anniversary. This little volume is now so rare, that I have brought it here, in part because it may be of interest to some to see it, but mainly because its time-stained pages would prove more eloquent than any words of the speaker. It is the author of this little catalogue in whose honor we are assembled. I am aware that on occasions like the present it is customary for the speaker to assume that the hearers are quite in doubt as to the person spoken of, and to relieve their minds only at the close of his speech, by announcing the name of the one who has been eulogized. Unskilled in the arts of the table orator, and quite sure of being unable to keep this company in a state of suspense, I go directly to the point and say that the author of the catalogue is Doctor JOHN TORREY.

As we look through the pages of the volume, we are astonished at its completeness, and wonder that a mere youth could have accomplished the great amount of preparatory labor necessary to the task.

In imagination we can look back over the intervening half century, and see the young enthusiast herborizing in localities that are to be found only in this catalogue. The "Swamp behind the Botanic Garden," and the "Bog-meadows near Greenwich" have long ago been built over, and the "Love-lane" is now a paved street. The station here recorded for *Draba Caroliniana* has ceased to be available to the botanist of the present day, as that plant no longer grows, according to the catalogue, "In sandy fields about Canal street." Not only have localities disappeared, but those whose names are associated with them, and who are recorded as having contributed material to the catalogue, have passed away also. Mitchell, Nuttall, Rafinesque, Eddy, LeConte, Cooper, and others, while they live in the memory of a few of those present, are to the most of us known only by their works. From this catalogue as an initial point, let us briefly survey the succeeding half century with reference to the botanical works of its author.

In 1820, there appeared in Silliman's Journal, vol. 4, *A Notice of Plants collected by Capt. N. Douglass around the Great Lakes at the Head-waters of the Mississippi.*

In 1823, the Annals of the New York Lyceum of Natural History contained the first instalment of the many precious contributions made by the author to our knowledge of the plants of the far West. Its title is, *Descriptions of some new or rare Plants from the Rocky Mountains, collected by Dr. Edwin James.*

In 1824 was published, *A Flora of the Northern and Middle United States, or a Systematic Arrangement and Description of all the Plants heretofore discovered in the United States north of Virginia.* But one volume of this work was published, and as a portion of the edition was destroyed by fire, it is now only rarely to be met with. It contains over five hundred pages, and includes the first twelve classes of the Linnæan System.

In the same year, 1824, we find in the Annals of the Lyceum, *Descriptions of new Grasses from the Rocky Mountains;* and in the same volume Dr. Torrey appears as editor and joint author with Schweinitz, of *A Monograph of the North American Species of Carex.*

The year 1826 was marked by the publication of the *Compendium of the Flora of the Northern and Middle States*, a work so full, concise, and compact, that it was indeed "a compendium." Probably some of those present can remember when this volume came to their relief, and the delight with which they turned to its brief diagnoses, after puzzling over the vague and unsatisfactory descriptions of other works.

On the 11th of December, 1826, our author read before the Lyceum, *Some Account of a Collection of Plants made during a Journey to and from the Rocky Mountains, in the Summer of* 1820, *by Edwin P. James, M. D., Assistant Surgeon U. S. Army.* This paper was not published until 1828. It is a memoir of some eighty pages, and enumerates 481 plants, many of which were new species. This was, up to the date of its publication, the author's most important contribution to science, and is even now frequently referred to by the student of our Western plants. It besides has an especial interest, as it was the first American work of any importance in which the arrangement was according to the Natural System. The only exception to this is a list by Abbé Correa, of the genera in Muhlenburgh's Catalogue, arranged according to the Natural Orders of Jussieu. *A Catalogue of North American Genera of Plants, arranged according to the Orders of Lindley's Introduction to Botany*, was published in 1831, both in a separate form, and as an appendix to an American edition of Lindley's work.

In 1836, the Annals of the Lyceum are rich with the *Monograph of the Cyperaceæ*, and the volume for 1837 contained a memoir on *New Genera and Species of Plants.*

The year 1838 saw the commencement of the *Flora of North America, by John Torrey and Asa Gray*, which was published in numbers and at intervals until the year 1843. The rich treasures brought in by our Western explorers interrupted the continuance of this work, and its authors directed their energies to plants from hitherto untrodden fields. That elaborate work, in two large volumes, *The Flora of the State of New York, by John Torrey*, was published in 1843, a year which began a remarkable era in American botany. In that year commenced that magnificent series of contributions to our western flora by Torrey, Gray, and others, which followed one another in rapid succession. Nicollet's plants, published in his report in 1843, was the first of this almost continuous series of memoirs, of which I will mention only those wholly or in part by Dr. Torrey. That daring young Lieutenant of the Topographical Engineers, now General Fremont, made two expeditions to the Rocky Mountains, the botanical results of which appeared in 1845. The report of the plants collected by Emory followed in 1848.

In the Smithsonian Contributions we find three memoirs by our author accepted in 1850, though they were not published until a year or two later. These were *A Memoir on Batis*, another on *Darlingtonia*, and *Plantæ Fremontianæ*, which last contains descriptions of some new plants collected by General Fremont in his memorable expedition to California.

The year 1852 gave us the plants collected by *Stansbury in the Region of Salt Lake*. The plants of *Marcy's Red River Expedition* appeared in 1853, and those from *Sitgreaves' Zuni and Colorado Journey in* 1854, all by Dr. Torrey.

The rich collections made by the botanists attached to the several Pacific Railroad Surveys, were published in 1855 and 1856. The plants of some of these expeditions were elaborated by Newberry, Durand, and others. Those collected by Beckwith and Gunnison, and by Pope on the Llano Estracado, appeared under the joint authorship of Torrey and Gray. The botanical portions of the reports of Parke, Williamson, and Whipple are by Dr. Torrey. The report of Whipple's Expedition is the most extensive of all these Pacific Railroad contributions to botany, as the journey crossed a country not heretofore penetrated by any botanist, and one which afforded a rich harvest not only in new species, but new genera. To the other reports, those which do not bear his name as author of the botanical portion of them, he contributed freely, often working up entire families.

The most voluminous, as well as in some respects the most important of the Botanical Reports of the Government Expeditions is that of the Mexican Boundary, published in 1859, and with this I close this chronological account, remarking that some of Doct. Torrey's contributions to botanical science have been omitted altogether.

This little catalogue of 1817 began the list, and it closes with the elegant quarto of the Mexican Boundary. Indeed there is no student of American Botany who has not almost daily occasion to refer to the works of TORREY.

Is it not fitting, then, that we should celebrate the fiftieth anniversary of the opening of a career that has brought so many benefits to us, and has given such lustre to American Science? I have spoken of what would seem to be the work of a lifetime; but when we recollect that all this was done aside from other duties, as recreation from labor, as it were, we can only wonder at the zeal and industry it indicates. But those who estimate the services of Dr. Torrey to botany from his published works alone, omit a large and important share. Those present do not need to be reminded of the personal aid he has given them in their studies. What lover of plants, however young or unskilled, ever failed to receive his patient attention and kind word of encouragement? Not only those who have had the advantage of personal acquaintance with him, have been the recipients of this aid, but those who have never met him have felt it through his correspondence. These are works that will never be published, but they are deeply imprinted on the hearts of botanists in all parts of the country.

It may be thought that this hurried review of the botanical labors of our guest is incomplete, without some reference to his character as a man.

It is always a delicate task to speak fittingly of another in his presence; and I could hardly trust myself to give utterance to what I feel is due him. Happily I am saved from the embarrassment that the attempt would bring, by speaking what is in the thoughts of all here present. Every one who has been brought in frequent communication with him knows that he has forgotten the philosopher in the friend, and that he has been made not only a better botanist, but a better man.

Many years ago, Arnott published in Taylor's Annals of Natural History a description of a new genus, established on one of the beautiful Conifers of Florida, and gave it the name of *Torreya*. The Florida species is *Torreya taxifolia*. Since then there have been added to the genus *Torreya nucifera* from the islands of Japan, *Torreya Californica* from the Pacific coast, and possibly another from northern China, *T. grandis*. While we are glad that so fine and widely spread a genus should bear the name of our friend, we regret that Arnott had not been more happy in his choice of a term to designate our American species. Though a native of Florida, it is hardy on this island, and even as far north as Fishkill, on the Hudson. It holds its bright foliage through the cold and snows of winter, and its presence here suggests thoughts of more genial climes and seasons. Had Arnott possessed the power of prophecy, he surely would have written *Torreya sempervirens;* for does not he whose name it bears disregard the frosts of time? Does not his presence always bring genial summer, and show us that years make no winter in the heart which has not lost the freshness of youth, but in which love — love to man and to God — reigns supreme? Long after the flowers shall have bloomed above us all, future botanists will carry on the work he has so nobly helped. Those yet unborn will wander by the Southern rivers, visit the mountains of far-off Japan, or climb our own grand Sierra Nevada in search of the Torreya, and his name will be remembered as long as there shall be botany and botanists. But these can only talk of him whom it is our priviledge to know, to honor, and to love, and whose presence we now greet with the already too-long delayed sentiment: Long life, health, happiness, and every blessing to our honored guest, Doctor JOHN TORREY.

Doctor Torrey, after feelingly expressing his thanks, and the surprise which this demonstration was to him, gave an interesting account of his first introduction to the study of botany, and the great difficulties that attended the student in those days. Botanical books, which, or their equivalents, are now to be had by every one, were then only to be found in the library of the New York Hospital. Doctor Torrey gave an account of some of the earlier teachers in the science, — Hosack, Eddy, Mitchell, and others, and a sketch of the history of the Elgin Botanic Garden.

The next regular sentiment was, "The Flora of North America; its past history and future prospects." This was responded to by Professor Gray, who facetiously remarked that he hardly knew what "Flora" was intended; but taking one view of it, if he were to judge from the number of young devotees that he saw, he should consider Flora's prospects very flattering. He spoke of those who were collaborators in the Flora of North America, and especially of Sartwell and Dewey, both of whom had recently died, and to whose memory he paid a feeling tribute.

Dr. Pickering, who was with the U. S. Exploring Expedition, replied to a sentiment referring to government aid to science; Professor Eaton, to one on botany in our colleges. The Flora of California was the subject of remarks by Professor Brewer, which were interesting as well as humorous. Mr. Wm. Leggett, of the club, gave an account of the new local Flora now in preparation. Mr. James Hogg, a member of the club, spoke of the relations of botany to floriculture. Professor Porter, Mr. S. T. Olney, and Professor Trail Green each made pertinent speeches.

One of the interesting events of the evening was the production by Mr. T. P. James of a manuscript volume found in the Library of the Academy of Natural Sciences of Philadelphia. Although the writer's name is not given in the volume, yet from the places visited and the plants mentioned, there is no doubt that it is the diary kept by Pursh while he was in this country. It is very minute in its accounts, and is written in such imperfect English, that readings from it created much merriment. It came into the possession of the Academy with the plants belonging to the late Dr. B. S. Barton, who, it is well known, was a friend and patron of Pursh. Professor Gray remarked upon the singular way in which things long separated would sometimes come together. He had, from the sale of Lambert's library in London, a MS. map of the United States, with Pursh's route traced upon it, and as that evidently belonged with the diary, he should take pleasure in presenting it to the Academy.

Letters were received from many botanists who were unable to be present. Among them were Professor J. S. Newberry, W. D. Brackenridge, Professor S. F. Baird, Edward Tatnall, General J. C. Fremont, Horace Mann, Doctor Robert Bridges, Doctor I. M. Bigelow, Charles Wright, William Boot, Doctor George Engelmann, William Canby, Professor J. T. Rothrock, Dr. J. W. Robbins, L. Lesquereaux, George Vasey, Hon. George W. Clinton, Dr. J. Carson, Professor E. Tuckerman, Professor J. Lewis Russell, Dr. Z. Pitcher, Professor J. P. Kirtland, and Dr. Jacob Bigelow.

A number of the letters were read by Dr. F. J. Bumstead; that from Doctor Jacob Bigelow was listened to with especial interest, it being from the oldest American botanist. As its perusal will doubtless gratify others, we give it here.

BOSTON, Dec. 12, 1867.

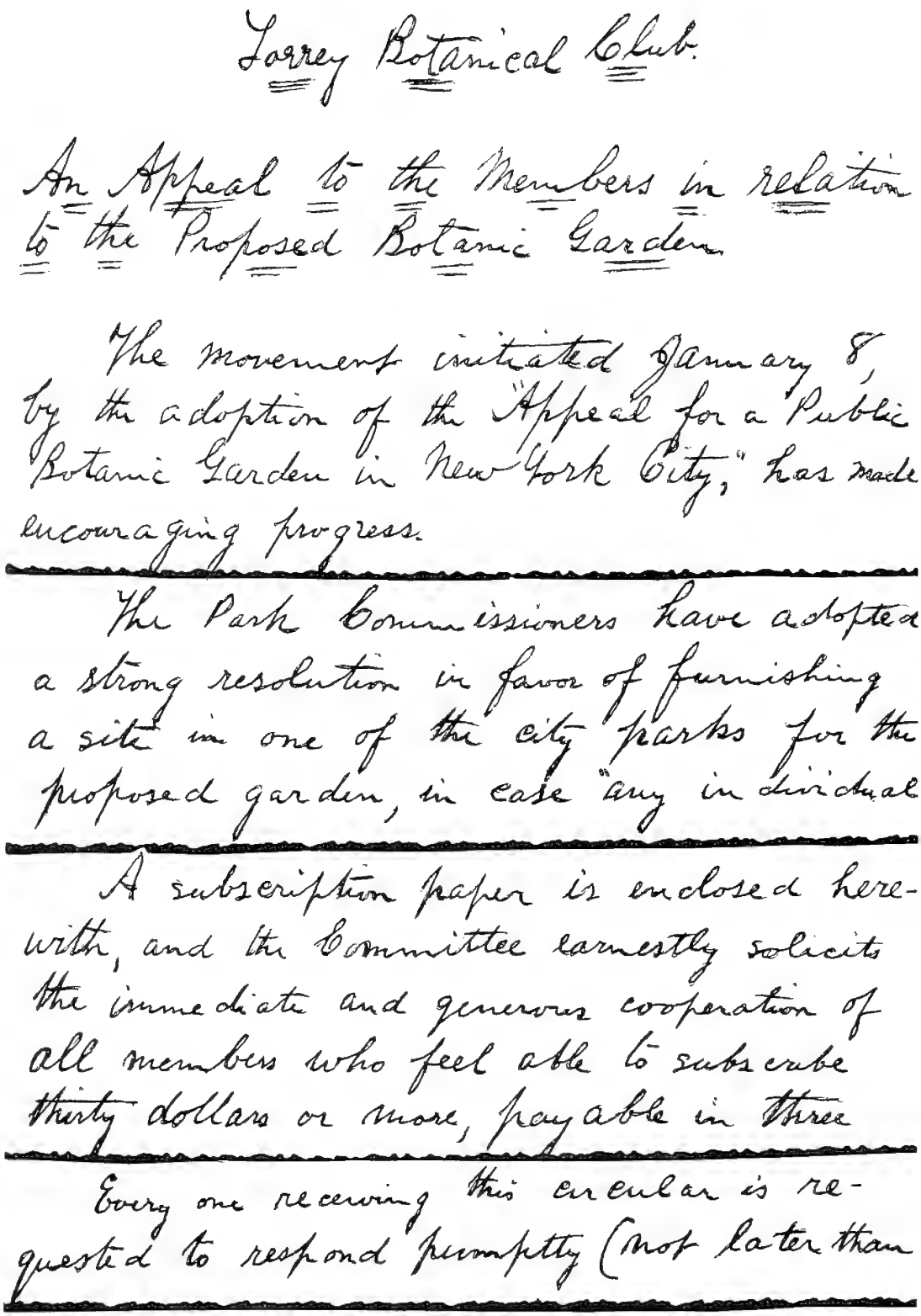
GENTLEMEN, — Your kind and flattering invitation, requesting my presence at a supper to be given in New York in honor of my much respected and long-esteemed friend, Dr. John Torrey, is received with much gratitude. If it were now May or June instead of bleak December, I should be irresistibly tempted to join in your appropriate festivity. But as there is at present no travelling conservatory between Boston and New York which can be relied on effectually to exclude the frost, I am obliged reluctantly to give up the proffered pleasure. My acquaintance with your honored guest, Dr. Torrey, dates back for half a century. At that distance of time, I had devoted myself considerably to botanical studies, and had published a little work on the plants of Boston. Dr. Torrey, who was then meditating a national work on North American plants, with more kindness than discretion, wrote me a letter, generously offering me the use of his collections, notes, and personal assistance, if I would undertake the enterprise. Fortunately for Botanical Science, I declined the responsibility, and the work has since been wholly carried out by himself and his distinguished colleague, Professor Asa Gray. For myself, I have been obliged to confine my herborizations mostly to the pavements of the streets, though at times I have broken loose in pursuit of my first love, and have gathered plants on the Rhine, the Rhone, the Tiber, and the Danube, not overlooking the St. Lawrence and the Missouri. In June of last summer I found myself culling simples at Fort Harker, away among the buffaloes and prairie dogs on the Smoky-hill Fork of the Kansas River.

Although if a scientific section of my trunk were now to be made, it might exhibit about four-score annual circles, yet I am happy to state that the ligneous fibres appear thus far to do their duty, and the sap vessels to transmit their contents. And I confidently trust that on no occasion will my botanical friends find me to be hollow-hearted.

I am, gentlemen, with the greatest respect, your obedient servant, JACOB BIGELOW.

the fiftieth anniversary of his completion of the manuscript for *A Catalogue of Plants growing spontaneously within thirty miles of the City of New York*, actually published in 1819. At this meeting of a group that later became the Torrey Botanical Club, Dr. Torrey, responding to the eulogies accorded to him, "gave an interesting account of his first introduction to the study of botany" and "of some of the earlier teachers in the science—Hosack, Eddy, Mitchill, and others, and a sketch of the history of the Elgin Botanic Garden."

It seems, then, that the memory of Dr. Torrey's outspoken tribute to that first American botanical garden which had attracted him as a boy was responsible for the immediate and sympathetic response by the Torrey Botanical Club when the idea of establishing a major botanical garden in New York City was proposed to it some twenty years later. Dr. Nathaniel Lord Britton, an instructor in botany at Columbia University, took his new wife to spend the summer of 1888 at the Royal Botanic Garden at Kew, near London, and both of them came back with the firm conviction that New York must finally develop its long-needed botanic garden. Inspired by the Brittons' enthusiastic and vigorous support of this proposal, the Torrey Botanical Club issued in 1889 a clear and persuasive statement of the urgent need for such an institution, whose purposes were included in the following paragraph: "The uses of a botanic garden may be reckoned as of four sorts. First and foremost is the purely scientific and educational use. Subsidiary to this, but still of a marked degree of importance, are the pharmaceutical and horticultural uses, and, lastly, the general use as a place of agreeable resort for the public at large." This appeal, "unanimously adopted and ordered to be printed for general circulation, at a regular meeting of the Torrey Botanical Club, held January 8, 1889," was successful in attracting the attention and in arousing the enthusiasm of a group of prominent citizens who, in 1891, founded The New York Botanical Garden as a corporation chartered by the State. [The "Appeal



Torrey Botanical Club.

An Appeal to the Members in relation to the Proposed Botanic Garden.

The movement initiated January 8, by the adoption of the "Appeal for a Public Botanic Garden in New York City," has made encouraging progress.

The Park Commissioners have adopted a strong resolution in favor of furnishing a site in one of the city parks for the proposed garden, in case "any individual

A subscription paper is enclosed herewith, and the Committee earnestly solicits the immediate and generous cooperation of all members who feel able to subscribe thirty dollars or more, payable in three

Every one receiving this circular is requested to respond promptly (not later than

Facsimile portions of a letter to members of the Torrey Botanical Club, probably sent in 1889. The letter states, "The Park Commissioners have adopted a strong resolution in favor of furnishing a site in one of the city parks for the proposed garden, in case 'any individual or association shall provide sufficient means' for its establishment. The amount required by the Commissioners is One Million Dollars and the Botanic Garden Committee has determined to make a concerted and resolute effort to obtain subscriptions from the friends of the movement for as large a share of this sum as possible." "These subscriptions will never become payable unless the entire million dollars should be pledged, thus assuring the establishment of the garden and thereby a glorious triumph for the Club, amply sufficient to recompense its members for very considerable sacrifices."

(To facilitate reading, this document has been typeset from a typewritten transcription of the original penned Minutes.)

MINUTES OF THE TRUSTEES OF COLUMBIA COLLEGE 5 NOVEMBER 1860

The following Communication was received from Dr. Torrey.

To the Trustees of Columbia College

Novr. 5, 1860.

It is probably known to most of the Trustees that a large portion of my life has been devoted to the prosecution of Botany, & especially to the study of the Flora of North America. Since the year 1818 I have been constantly laboring in the collection of materials for perfecting our knowledge of our indigenous plants. For this purpose it has been necessary to accumulate an enormous herbarium, not only of the plants of our own country, but of all parts of the world, wherever they could be obtained. My Herbarium now embraces about 40,000 species & varieties, & is constantly increasing. It fills an entire story of my house. My botanical library contains nearly 600 volumes, among which are many rare & costly works, which can now be obtained only with great difficulty; & not a few are scarcely to be purchased, except at long intervals, on the breaking up of private botanical libraries.

The Herbarium embraces the original specimens of the plants described in the Flora of North America by Dr. Gray & myself. It contained nearly all the Botanical Collections made by order of the United States, & by the Legislatures of the different States, since the year 1818, including those made in Long's, Fremonts, Sitgreave's, Emory's, and all the Pacific Rail Road Explorations; as well as the very large collections made during the five years occupied in the Mexican Boundary Survey. On nearly all these plants, I have made full Reports which have been published by the United States, with several hundred engravings. The herbarium is enriched also with the collections, made by the United States expeditions sent to the Isthmus of Panama, & a full set of the plants found by Professor Holton, in his Botanical travels in New Granada.

The contributions made to my herbarium by private botanists throughout the United States, & the collections made by myself for the last forty years amount to many thousand specimens. I have also most of the plants collected in British America from the first voyage of Parry, the voyages of Ress & Sabine, & the two journeys of Franklin, kindly presented by Sir William Hooker, Director of the Royal Gardens at Kew, who by permission of the Lords of the Admirality, distributed the duplicates obtained by those eminent explorers. Sir William has also supplied me with numerous plants from his own unrivalled herbarium. Through the East India Company, I have received a large number of Specimens collected by their botanists in India. Most of the eminent botanists in England, Scotland, and the Continent of Europe have made contributions to my Herbarrium, & it has also received very many plants from the Museum of Natural History at Paris, the Imperial Academy of St. Petersburg, & the Imperial Soc[iety] at Moscow.

The herbarium is arranged on the Natural System. Each species or variety of plants is securely glued to a half sheet of strong white sized paper, manufactured expressly for the purpose, & an authentic name attached, with information as to the locality, donor &c. The species of each genus or subgenus are laid in a cover of thicker & tinted paper, & the whole placed on shelves or large pidgeon holes in imitation-oak cabinets. By means of a key, or index, any plant can be found as easily as a word in a dictionary.

The importance of an extensive & authentically named herbarium is of the greatest importance to the student of Botany, & especially to one who is engaged in original investigations in the Science, or who wishes to prepare a local or general Flora.

The herbarium that I have been so many years in bringing together must necessarily be consulted by all future writers on the Botany of this country, because the Flora of North America, on which, in connexion with my friend Dr. Gray, I have worked for 25 years, is the only work that includes the plants of all our States & Territories, as well as of the British possessions to the north of us.

I am desirous, therefore, that my herbarium should be placed where it should be permanently fixed, and where it can be consulted with facility by working botanists. It has long been my desire that it should be possessed by Columbia College, so that it may remain in the city of my birth.

The proposal that I make to the Trustees is, that the College shall receive the entire collection & my Botanical Library, for five years rent of a house in the College Green that is now unoccupied, & which is not required for any other purpose.

Very respectfully

John Torrey.

The present cases are sufficient for three fourths of the Collection. In a line they would occupy about seventy five feet. The accessions amount to 2000 – 4000 yearly.

If a Curator were appointed for about 250 or 300 dollars a years, I would, without expense to the College, deliver lectures on Botany (in its various Departments) and give instruction in the use of the microscope, to the Students of the College, to any desirable extent.

J.T.,

RESOLVED that the proposition of Dr. Torrey, be accepted, and that it be referred to a Special Committee, to acknowledge the donation & arrange the necessary details.

The President, Dr. Jay, and Mr. Allen were appointed the Committee.

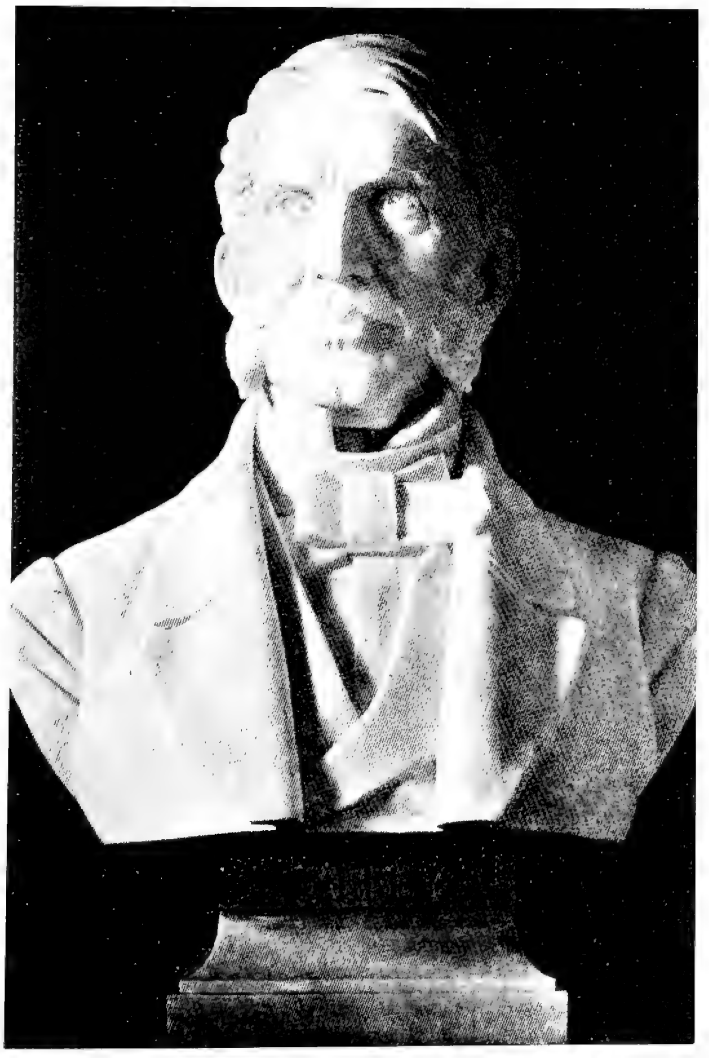
RESOLVED that the thanks of the Board be returned to Dr. Torrey for his liberal donation, and his enlightened consideration of the highest interest of the College: and that a Copy of these Resolutions be presented to him.

for a Public Botanic Garden in New York City" is reproduced on the back covers of this magazine.]

John Torrey was a pioneer in many ways. Starting without adequate botanical literature for his work and without a major herbarium available, John Torrey accumulated, largely through his own labors, both an outstanding library and a herbarium, which in 1860 he offered to Columbia College (now University) in a moving document, "so that it may remain in the city of my birth." After the establishment of The New York Botanical Garden, the Regents of Columbia University agreed to place the university's magnificent herbarium, then largely that of Torrey, on indefinite loan to the new institution, where it remains today. His professional correspondence, manuscripts, and library accompanied the herbarium—a library consisting of books that even in 1860 he described as "rare and costly." In March, 1967, as part of the centennial celebration of the Torrey Botanical Club, an attractive and spacious room under the dome of the Museum Building was dedicated by the Botanical Garden as the John Torrey Room, for the use of the Torrey Botanical Club—the local herbarium of "plants growing spontaneously within thirty miles of the City of New York" was placed in it. A large and handsome portrait of Dr. Torrey (see cover), on indefinite loan from Columbia University, forms an appropriate adjunct to the Torrey Room, and we are now searching assiduously for a marble bust whose present whereabouts is quite unknown, even though its existence is proven by a published photograph.

Thus, by many surprising coincidences, John Torrey has come to be identified today with The New York Botanical Garden. The forces he set in motion were reinforced by the Torrey Botanical Club and finally culminated successfully in the establishment of a major botanical garden in New York City. Through this cycle of events, then, we see how the man and the institution became so firmly related. ■

Dr. William C. Steere, Director of The New York Botanical Garden, welcomed Torrey Botanical Club members to their "headquarters," the John Torrey Memorial Room under the dome of the Museum Building, on March 25, 1967.



Mrs. William J. Robbins showed manuscripts relating to John Torrey to Dr. Ralph H. Cheney, President, Torrey Botanical Club, and Dr. Frank J. Pokorny, during the dedication of the John Torrey Memorial Room.

This photograph of a marble bust of John Torrey appeared in "Pioneers of American Science," published by the American Museum of Natural History in April, 1907; it illustrated an article about Torrey by Nathaniel L. Britton. The size of the sculpture, the identity of the sculptor, and—most important of all—the whereabouts of the bust now, are not known.

THE TORREY BOTANICAL CLUB: A Retrospect

By Harold William Rickett
Historian, Torrey Botanical Club

A little over a hundred years ago, persons interested in wild flowers would resort to the Herbarium of Columbia College, where they would find old Doctor John Torrey, Professor of Botany and Chemistry, ready to answer questions, to identify specimens, and generally to further their enthusiasm in the pursuit of botany. In those days botany was chiefly classification—taxonomy—and there was no one in America better qualified to promote this than Torrey. When plants were collected even as far away as the borders of Mexico by the various exploring expeditions sent out by the United States government, the specimens were sent back east to the leading botanists of the day; and foremost among these was John Torrey. Yet with all this eminence, he remained a modest, kindly, and lovable man, always ready to share in the simple pleasures of collecting and identifying wild flowers around the City of New York.

The amateur botanists who gathered round Torrey gradually began to think of themselves as a "club," a botanical club: of course without officers or a formal constitution, just a group of persons with similar interests and a revered master. As meetings became more regular and walks in the country more organized, the group became more self-conscious, calling itself the Torrey Botanical Club. Exactly when this first happened cannot now be determined. But in December 1867 a dinner took place at which the existence of the Club, and its name, were recognized; and from this event we can date its official beginning.

From that parturition the Club emerged with a singular vitality. In those days interest in such an inoffensive and uncommercial pursuit as the collection and naming (in Latin!) of wild flowers was prevalent in many parts of the world, and resulted in many associations and publications. In 1870 there were thirty members of the informal Torrey Botanical Club. The Club was incorporated in 1872, officers were elected, meetings were held at regular times, and minutes were placed on record. In 1870, William Henry Leggett, a teacher of classical languages in a high school, had begun to publish, on his own initiative and at his own expense, a "Bulletin," to further communication between members and to record the species of wild flowers found around the city. Other topics of "general botanical interest," however, were not excluded.

Torrey died in 1873, mourned by botanists everywhere and especially by his friends and pupils in the infant Club. But the meetings, and the walks in the country—field trips, as we call them—continued, under the leadership of other botanists. And the *Bulletin* continued, being after a few years taken over by the Club, and adding to its contents the minutes of meetings and reports of field trips, to become what is today, in its ninety-fourth volume, the oldest serial in America devoted to botany, in all the diversity of its "general interest." Through the years, contributions have been received from botanists all over the United States, from most countries in Europe, from India, China, Mexico, and from several of the republics of South America. And since the *Bulletin* from early times was sent free to all members, and since the annual dues were as low as or even lower than the price of a subscription, botanists all over the country and even abroad have become members of the Club, without any prospect of attending a meeting or participating in a field trip. For many years, indeed, the researches that filled the pages of the *Bulletin* were accompanied by the minutes of the meetings and reports of the field trips, in which those who lived far from New York had little or no interest. The Club was leading a double life and had given birth to a two-headed calf. It was as if the officers of the Club and the other botanists of New York City did not realize the scope and value of the serial they were publishing.

Perhaps the Club did become aware of its duplicity, for in 1900 a new serial began to appear, appropriately named *Torreya,* for the publication of shorter and less technical papers and the proceedings of the Club. This existed for forty-five years, remaining a small magazine as the *Bulletin* grew larger, and managed by a different editor. It was finally absorbed by the older serial, the factors that ended its independent existence being (1) the greatly increased cost of printing, and (2) the fact that its pages were from the first occupied by highly technical articles, often the descriptions of new species, by professional botanists. It retained its name as a department of the *Bulletin,* and better fulfilled its original professed aims in the publication of minutes and reports of the Club, notices of local plants of unusual interest, biographies of local botanists, and the like. Perhaps it is as well that widely scattered professionals should be reminded, when they see the *Bulletin,* of the existence of a devoted group of amateurs. Such enthusiasts have often been the foundation of scientific botany.

Another adventure in publication has been more successful, so far as success is measured by permanence. In 1889 the Club instituted the *Memoirs,* to publish papers too long for the *Bulletin.* A distinguished series of monographs and reports have appeared, at irregular intervals, under this title. They form an essential part of the great body of American botanical literature.

Until a few years ago the *Bulletin, Torreya,* and the *Memoirs* were sent without charge to every full member of the Club. How were they all financed? During recent years the annual dues of members barely paid for the printing of the *Bulletin.* The other publications and activities of the Club—meetings, field trips, administrative expenses—were subsidized from private sources, chiefly from the generous bequest of Nathaniel Lord Britton (of whom more later). Even this was not enough to support the *Memoirs* in addition to all the other charges, and these are no longer distributed free to members. Though of great scientific importance, they scarcely have the circulation of *Life* or *The New Yorker;* yet they pay their way. *Torreya* has enjoyed resurrection in somewhat ghostlike form, the pages in the *Bulletin* being separately printed and distributed to Associate Members (who do not receive the *Bulletin* itself).

A feature of the *Bulletin* almost from the beginning was the "Index to American Botanical Literature," compiled by the officer termed the Bibliographer. "American" was construed in the widest sense as referring to the entire Western Hemisphere. The "Index" was a listing of current papers, arranged alphabetically by authors; sometimes accompanied by brief descriptive notes. At first the titles were almost all taxonomic, but, as the years passed, their volume and complexity were multiplied. In 1942, W. H. Camp suggested that they should be organized in the different branches of botany; and this was done. The sections of relevance in taxonomy were reprinted in *Brittonia* for the American Society of Plant Taxonomists, forming a continuation of their "Taxonomic Index." The Index itself was reprinted issue by issue on cards, which were sold to a limited number of libraries. They form an invaluable research tool in the catalogue of the library of The New York Botanical Garden. Recently [1966] it was proposed to terminate the Index. This raised a howl of protest from many quarters; its fate is still unsettled.

The field trips have continued, under varied and always enthusiastic

Facsimile of a portion of the printed report of W. H. Rudkin, Treasurer, of the Club's financial condition at the end of 1886.

Condensed Statement.

Year.	Income of Bulletin.	Income from other sources.	Received from Leggett Fund.	Total.	Expenses of Bulletin.	Other Expenses.	Purchase of Back Vols. Leggett Estate.	Total.	Bulletin paid per cent of its cost.
1881	$364 13	$87 00	———	$451 53	$441 28	$10 25	———	$451 53	80 p. c.
1882	382 16	140 33	———	522 49	505 41	13 10	———	518 51	75 p. c.
1883	392 70	153 98	———	546 68	489 56	46 35	———	535 91	80 p. c.
1884	391 71	154 77	———	546 48	439 51	106 97	———	546 48	89 p. c.
1885	329 21	186 00	———	515 21	435 34	78 00	———	513 34	75 p. c.
1886	615 75	196 29	100 00	912 04	679 08	125 98	100 00	905 06	89½ p. c.

leaders. That first group of naturalists who met with Doctor Torrey would go on walks with him in the country around New York. Their aim was to compile a list of the species growing wild in the region; installments of this list were a feature of early volumes of the *Bulletin*. With the publication of comprehensive manuals of the northeastern states, the purpose of the field trips changed; they became a means of acquainting the amateur with plants in their natural environment, and especially the less common and more interesting species. Even yet, however, species new to the country around New York are reported. Of course, as Megalopolis spread through the countryside, the walks were aided by train and automobile, and the places visited were farther afield. During the last few years visits have been made to many places in Westchester County, Staten Island, Rockland County, and the nearer parts of New Jersey. Longer excursions—often overnight—were to the Catskill Mountains, to Vermont, to the Mt. Katahdin area of Maine, to the Great Smoky Mountains, and to the Gaspé Peninsula. Most of these more ambitious journeys were in cooperation with and often at the invitation of other societies: the Vermont Bird and Botanical Club, the Appalachian Mountain Club, and the Botanical Society of America.

The indoor meetings of the Club have gradually changed their character. At first, like the field trips, they were chiefly concerned with the local flora, including extensions of range, variations in character, and so on. Then they became more and more given to the presentation of research, in any field, by members of the club. They were formerly held one afternoon and one evening a month; now they are only evening events. They occur at the principal institutions of the city, The New York Botanical Garden, Brooklyn Botanic Garden, The Boyce Thompson Institute for Plant Research, Hunter College, Fordham University, and the Botany Department of Columbia University. They are mostly discussions of research, of the latest findings in some special branch; but

Vol. IV., No. 3.] BULLETIN OF THE TORREY BOTANICAL CLUB. [New York, March 1873.

DEATH OF DR. TORREY.

On the evening of the 29th of January, Dr. Torrey presided at the meeting of the Club for the last time. We all noticed that he looked more infirm than usual, and the shadow of the coming event fell upon us. The next day he had an attack of pleurisy, which left him too weak to recover. He preserved, however, the clearness of his mind to the last. Not being able to meet with us on the 25th of February, he sent us a cheerful note and a botanical communication which we publish below. He died about 6 P. M., Monday, March 10th. The funeral services were performed at Dr. Hastings Church, on 42d Street, Thursday, March 13th. The members of the Club from far and near attended in a body, each wearing a sprig of *Torreya*, as an appropriate badge. Among the mourners were representatives of the Society of the Cincinnati, and of the various academic and scientific associations with which the Dr. had been identified for the greater part of the century. The pall-bearers were Dr. Parker, Dr. Delafield, Dr. Agnew, Prof. Asa Gray, Prof. Henry, Gen. Roome, President Barnard, and Mr. Albinola. The profuse offerings of flowers to mark affection for the dead were certainly never more appropriate. The body was conveyed the next day to Woodlawn Cemetery.

Dr. Torrey was in his 77th year, and from boyhood had been devoted to Science, and rendered her effective service. When a mere lad, as we have heard him relate, he corresponded with Curt Sprengel, one of the most eminent botanists of his day. His Catalogue of the Plants about New York was reported to the Lyceum, of which he was a founder, in 1817, when he was nineteen years old. His influence upon the development of the science of Botany in this country has been from that time to the present so large and so constant, and his intercourse with its students so extensive, so instructive and so genial, that probably every botanist in America feels that in him we have lost a scientific father and a personal friend. On another occasion a more competent hand will present the record of his contributions to Botany.

The sense of a great loss comes especially home to the members of the Club, who for the last six years have been in the habit of meeting him monthly. The social character of our reunions gave us opportunity to become acquainted not only with his learning, his sagacity, his caution, and his integrity—qualities inseparable from a high scientific standing; but also with his personal bearing, his enthusiasm, his ingenuosness, his friendliness, his geniality—charms which suffered no impair by the touch of time*. To be interested in Botany was a recommendation to Dr. Torrey: the person shared in his love for the science. This was touchingly shown in the tenderness with which he always recalled the departed, and to this trait, no doubt, was partly due his wide influence. The cordiality with

* On his return from Florida last Spring, the Dr. was rallied upon going to seek the Fountain of Youth, when he retorted, "Give me the Fountain of Old-age. The longer I live the more I enjoy myself." There is nothing finer in the *De Senectute*.

Facsimile of pages 9 and 10 of the *Bulletin of the Torrey Botanical Club*, Vol. 4, No. 3, March 1873. The unevenly inked pages appear in the original magazine.

which he extended to us the use of his library and herbarium, the kindly interest with which he entered into our inquiries, assisted us with his advice, and bore us in mind when he was absent in the South or West, and, in a word, the habit we had of referring to him in all our botanical interests, make us feel almost that with his the life of the Club has departed.

That this feeling exists is perhaps the most genuine homage that could be paid to the worth of our late President. Against it, however, it is our duty to strive. It was certainly not for want of social opportunities that a man so much in request gave up his evenings to us, but to foster the interests of his favorite science, to which the organization of the Club gave promise of contributing. And, on our part, when we adopted his name in his lifetime, the proposer of that title certainly, and probably all of us wished to convey to him the assurance that it was a name that we "would not willingly let die," but would endeavor to honor in efforts for the advancement of the study of Botany in this vicinity, and even more widely, if in any way we should be able. In fact we almost promised this in so many words the last time he met with us. It devolves upon us, likewise, as the only organization in this community especially devoted to this science, to watch over the interests of the Herbarium, in which we have had our being, and whose fate was a constant source of anxiety to its founder. The sense of these duties, it is believed, will carry the Club forward.

14. Dr. Torrey's last communication to the Club.—[Dr. Torrey not being able to meet with the Club, Feb. 25th, sent the following note to the temporary chairman.]

The day after the last meeting of the Club, I was attacked with Pleurisy. This, with very active treatment for several days, was cured, so that I suffered no more pain; but I was left so extremely weak, that ever since I have spent most of my time in bed. It is about a month that I have not been allowed to go down stairs. It is nearly fifty years since I had a sickness of more than a few days duration. My physician thinks that I am now slowly mending.

As *I* am not the *Botanical Club,* it seemed best that a regular meeting should be held, although I shall not be able to join your company. Tell the members how much I regret this deprivation; but I shall be with you in fraternal sympathy, and hope you will have a good time. I send, as my representative, the picture painted by my niece, Mrs. Daniell, of the Herbarium with your *chairman* sitting at his work! * * * *

The following you can read to the Club and then use it for the Bulletin. JOHN TORREY.

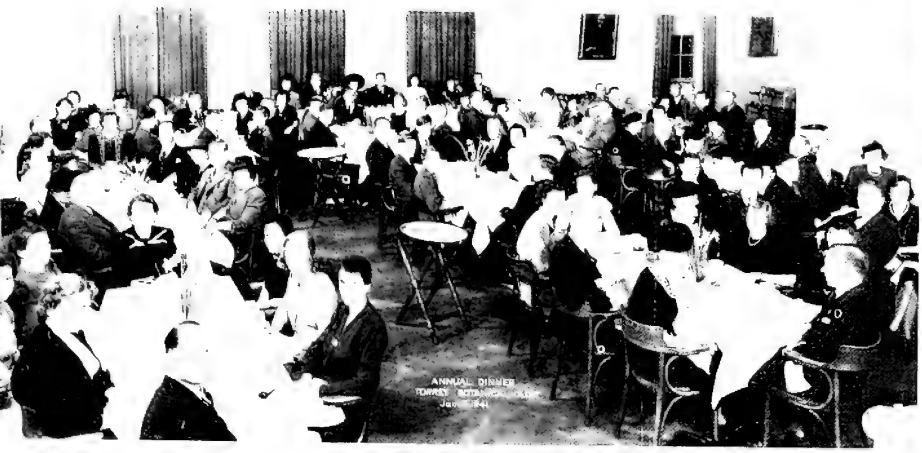
COLUMBIA COLLEGE, Feb. 25th, 1873.

15. On a new species of Phyllanthus.—In the Pacific R. R. Expedition of the late Gen. Whipple, in 1853-54, the botanist, Dr. G. M. Bigelow, collected, on the sandy banks of the Canadian River, a low annual plant having all the characters of a Phyllanthus, but differing from all the described species of that numerous genus (and indeed from the whole order of Euphorbiaceæ) in the position

are occasionally of popular character. The annual meeting, at which officers for the year are elected, takes the form of a banquet, which is attended by most of those in the metropolitan area interested in botany, and concludes with an address by the retiring president on a subject dear to his own heart. Besides these meetings in New York, the Club has also taken part in the national meetings of the American Association for the Advancement of Science and the American Institute of Biological Sciences, staging exhibitions and organizing symposiums.

Many distinguished botanists have contributed to the development of the Torrey Botanical Club, especially those who worked in and near New York City. Among the first of these was Nathaniel Lord Britton, Professor of Botany in Columbia College. In 1888 he and his wife (whom he met first in the pages of the *Bulletin,* Elizabeth Gertrude Knight being also a botanist) made a momentous journey to Europe. Britton was much impressed by the Royal Botanic Gardens at Kew. Why had America no such institution? He determined that it should have; and the result was the New York Botanical Garden, of which he was made the first director. The Torrey Botanical Club was responsible for raising the necessary endowment and procuring the necessary legislation; and the close connection between the Botanical Garden and the Club has persisted. The collection of specimens of the local flora gathered by members, the so-called local herbarium, is maintained at the Botanical Garden. So are the archives of the Club. Torrey's collections form part of the Britton Herbarium at the Botanical Garden. On March 25, 1967, a room in the Museum Building was dedicated to Torrey and made available to the Club for meetings and conferences. It is seldom that one or more officers of the Torrey Botanical Club are not drawn from The New York Botanical Garden. Bernard Ogilvie Dodge, famous for his pioneer studies on the genetics of fungi, was successively editor and president of the Club. The dean of American botanical bibliographers, John Hendley Barnhart, was editor,

Right, Torrey Botanical Club 75th Anniversary Celebration Dinner June 22, 1942. Below, Annual Dinner January 7, 1941. (Photographs courtesy of Dr. Annette Hervey.)



Torrey Botanical Club 100th Anniversary Celebration Dinner June 17, 1967.

Torrey Botanical Club members and guests on the steps of the Museum Building, The New York Botanical Garden, during the Club's 75th Anniversary Celebration, June 23, 1942. Dr. Harold H. Clum, formerly Honorary Plant Physiologist at the Botanical Garden, has identified 107 of the persons in the picture, as listed below.

1. H. K. Svenson
2. Robert Hagelstein
3. C. Stuart Gager
4. John A. Small
5. Harold C. Bold
6. Clyde Chandler
7. Wm. J. Robbins
8. Francoise A. Kelz
9. Albertine Kelz
10. John S. Karling
11. A. E. Hitchcock
12. Mrs. Jerome W. Coombs
13. Prof. Marie-Victorin
14. Mrs. Robert H. Fife
15. F. D. Kern
16. E. D. Merrill
17. Gertrude E. Douglas
18. H. A. Gleason
19. Ernest Ball
20. Virgene Kavanagh
21. James Marvin
22. Arthur Hillegas
23. F. W. Kavanagh
24. P. V. Mook
25. W. A. Dayton
26. Charles E. Allen
27. A. B. Stout
28. H. H. Clum
29. Hettie Chute
30. Robert Bloch
31. F. W. Pennell
32. Walter P. Green
33. Mrs. Ernest Ball
34. Mrs. A. J. Eames
35. Anna F. Jenkins
36. John Dodd
37. Unidentified
38. Ethel Welti
39. G. S. Torrey
40. Mrs. Mary I. Turner
41. Lloyd Weaver
42. George H. Shull
43. Clara S. Hires
44. Ruth C. Yates
45. F. L. Howard
46. R. H. Wetmore
47. Mrs. G. S. Powell
48. George S. Powell
49. Mrs. R. Hagelstein
50. Mrs. Fern Crane
51. Penelope Smith
52. Dorothy Meier
53. Jean Stewart
54. J. H. Barnhart
55. Gussie F. Miller
56. Margaret Fulford
57. E. P. Kilip
58. F. Lyle Wynd
59. Ann F. Bowler
60. A. J. Eames
61. Harriet Creighton
62. Grace Antikajian
63. Esther Zimmer
64. F. J. Seaver
65. Mrs. F. J. Seaver
66. Mrs. Helen Upson
67. D. Elizabeth Marcy
68. Carol Anderson
69. Unidentified
70. Lazella Schwarten
71. Mrs. R. R. Stewart
72. Alfred Gunderson
73. Aviva Kogon
74. Unidentified
75. Unidentified
76. Gordon Whaley
77. E. W. Sinnott
78. Annette Hervey
79. Anita Appel
80. Vivian T. Walker
81. M. A. Chrysler
82. Nettie M. Sadler
83. Myrtle Hinman
84. Sarah H. Harlow
85. Mrs. A. G. Vestal
86. Jennie L. S. Simpson
87. Erling Dorf
88. Norma Pfeiffer
89. Unidentified
90. A. G. Vestal
91. Dorothy Hammond
92. G. L. Wittrock
93. F. T. Lewis
94. R. R. Stewart
95. B. O. Dodge
96. Peter Johnston
97. Mrs. B. O. Dodge
98. M. A. Raines
99. A. F. Blakeslee
100. Mrs. E. D. Merrill
101. Cornelia Carey
102. Mrs. Marie Siegele
103. Unidentified
104. Roberta Ma
105. Stanley A. Cain
106. Ruth Patrick
107. J. P. Carabia
108. C. J. Porter
109. Roland Walker
110. John H. Pierce
111. W. H. Camp
112. E. B. Matzke
113. Frank Lier

TORREY BOTANICAL CLUB.

LIST OF MEMBERS.

Active, Honorary and Corresponding.

REVISED AND CORRECTED JANUARY, 1887.

The following list of active, corresponding and honorary members has been prepared under the resolutions of the Club adopted at the meeting held on March 9th, 1886, viz.:

Resolved, That after April 1st, 1886, all active members two years or more in default of payment of dues shall be placed on the list of corresponding members, unless they be residents of New York or vicinity, in which case they shall be considered as having resigned from the Club. The discrimination of such cases shall be left to the discretion of the Secretary and Treasurer.

Resolved, That the Secretary be requested to prepare a complete list of active, corresponding and honorary members, and to have the same printed for distribution.

The letter R represents *resigned*.

The letter D represents *deceased*.

An asterisk denotes that the member was one of the original incorporators of the Club.

ACTIVE MEMBERS.

Austin, Coe F.	Closter, N. J.	* D
Allen, Dr. T. F.	10 E. 36th St., N. Y.	*
Agnew, Miss Nellie C.	39th St. & Madison Av., N. Y.	R
Ayers, J. H.	220 Carleton Av., Brooklyn.	R
Amend, O. P.	205 Third Av., N. Y.	
Allen, Prof. J. A.	Am. Museum Nat. Hist., N. Y.	
Buchanan, Isaac	9 W. 17th St., N. Y.	* R
Bumstead, Dr. F. J.	24 E. 38th St., N. Y.	* D
Bower, William	53 Fulton St., N. Y.	*
Bedford, P. W.	100 Fulton St., N. Y.	R
Butler, Charles W.	Newburgh, N. Y.	R
Black, G. A.	159 W. 36th St., N. Y.	R
Bassler, H. R.	34 Barclay St., N. Y.	R

Facsimile of the first page of the Torrey Botanical Club Membership List for 1887, which lists 183 Active Members (the inclusion as "Active" of members who had resigned is not explained), one Honorary Member (Prof. Asa Gray), and 78 Corresponding Members.

vice-president, and president. Curiously enough, Britton, though for a number of years editor, was never elected president. Marshall Avery Howe was editor and, later, president. Fred Jay Seaver, Curator Emeritus, William Jacob Robbins, Director Emeritus, and William Campbell Steere, present Director, have all served as president. Many other past and present members of the Botanical Garden staff have served the Club in various official capacities.

Other institutions in and around New York have contributed distinguished names to the roster of officers (I am naming only those no longer living who were presidents of the Club): the Brooklyn Botanic Garden (Charles Stuart Gager); Columbia University (parent of the Club and grandparent of the Botanical Garden; Robert Almer Harper, Tracy Elliot Hazen, and Edmund Ware Sinnott); Rutgers University (Minton Asbury Chrysler); The Boyce Thompson Institute for Plant Research (Lela V. Barton); Fordham University (Charles Albert Berger); Hunter College; Long Island University; and Princeton University (George W. Shull).

While necessarily the officers of the Club, who must preside at meetings and manage its domestic affairs, are resident in or near New York, the pages of the *Bulletin* are filled with the researches of botanists of all the United States and of foreign countries. Among the most distinguished names, besides those already mentioned, were Asa Gray, Liberty Hyde Bailey, Thomas Hunt Morgan, Albert Spear Hitchcock, William Gilson Farlow, Merritt Lyndon Fernald, David Grandison Fairchild; and from abroad, Karl Immanuel Eberhard Goebel and Alphonse Louis Pierre Pyramus de Candolle.

When one passes in review the varied activities and publications of the Club and the roster of eminent botanists who have contributed to them, it is evident that this group, named for a local botanist and at first thought a purely local organization, has served very generously, perhaps more than any other society, in the development of American botany. ■

Field Trip Album

1893

Torrey Botanical Club group at Pelham Railroad Station May 20, 1893.

Slide Mountain, New Jersey, May 31, 1901. Dr. Britton right rear.

1901

1906

FIELD MEETINGS
OF THE
TORREY BOTANICAL CLUB
1906

Oct. 6th. Bulls Head, Staten Island. Leave South Ferry at 1 P. M. On landing at St. George take Shore Line trolley car to Port Richmond and get transfer to Bulls Head. Guide, Dr. Philip Dowell, who will meet party at Port Richmond. Fare about 20 cents.

Oct. 13th. The Ecology of Roots. Meet at Museum Building, Bronx Park, at 2 P. M. Instructor and guide, Dr. C. Stuart Gager.

Oct. 20th. Morris Park, N. Y. Special excursion for mosses. Meet at Museum Building, Bronx Park at 2 P. M. Guide, Mr. R. S. Williams.

Oct. 27th. College Point, Long Island. Leave foot of East 99th St. at 1 P. M. Guide, Mr. Roland M. Harper, who will meet party on arrival of boat at College Point.

Nov. 3rd. Visit to the Conservatory and Grounds of the New York Botanical Garden. Guides, Mr. Taylor and Mr. Wilson, who will meet party at "L" Station, Bronx Park, at 2 P. M.. Members are invited to attend the lecture by Dr. Hollick in the Museum Building at 4.30, subject, "Coal; its origin and development".

Nov. 10th. Fort Lee, N. J. Members will meet at foot of West 129th St. at 1 P. M. Guide, Dr. Tracy E. Hazen. Fare about 10 cents.

Nov. 17th. Scarsdale, N. Y. Special excursion for woody fungi. Leave Grand Central Station at 10.35 A. M. Returning, leave Scarsdale at 4.07 P. M. Guides, Mrs. F. M. Livingston and Miss A. B. Crane. Excursion fare 75 cents

On the completion of this schedule the Field Meetings will be discontinued for the season of 1906.

FIELD COMMITTEE, PERCY WILSON Chairman. New York Botanical Garden

Field Trip Album

1914

"Salt-Water Day," Crooke's Pt., Great Kill, Staten Island, New York, July 16, 1914. "Nat's [N. L. Britton] treat to the Torrey Club and the S. I. Assoc. of Arts and Sci. F. E. Lentz took the picture with a string. Dr. Harper, Norman Taylor, Ralph Benedict, Hollick, N. L. B., Dr. Mansfield, Mrs. Walsh & Addie Hollick, Eleanor, & a whole lot of folks from S. Id.

1942

TORREY BOTANICAL CLUB
75th Anniversary Field Trip
June 26-27, 1942

This trip has been planned so that those who wish may see two of our unique vegetation types, the off-shore bar flora and that of the pine barrens. The leaders will be Mr. E. J. Alexander, New York Botanical Garden; Dr. M. A. Chrysler, Rutgers University; and Dr. H. K. Svenson, Brooklyn Botanic Garden. It is arranged so that you may participate in all or any part of it.

ITINERARY

Friday, June 26:

7:15 a.m. Leave Pennsylvania Station N. Y. Buy one way ticket to Seaside Park. This group will include those who prefer to get afield early, even when in New York. It will provide some 2½ hours for botanizing in the vicinity of Point Pleasant and a search for Mackenzie's station for **Lilaeopsis chinensis** between Mantoloking and Chadwick. It may entail six or seven miles more walking than the later departure.

8:57 a.m. Arrive Point Pleasant.

9:35 a.m. Leave Pennsylvania Station, N. Y. Buy one way ticket to Seaside Park. FOR THOSE WHO PREFER A MORE LEISURELY START AND LESS WALKING. Ticket will cost $1.75 or $1.84. We have been quoted both rates.

11:28 a.m. Arrive Point Pleasant.

11:34 a.m. Leave Point Pleasant via Penn. Greyhound bus for Seaside Park. The early group will board this bus at Pt. Pleasant or below, we hope.

12:04 a.m. Arrive Seaside Park. Check in at hotel. Lunch.

1:00 p.m. Leave hotel for afternoon afield. There will undoubtedly be mosquitoes, the only uncertainty is about how many. Fly dope, sun glasses, and sunburn lotion may be in order. An easy walk is planned but there will be room for those who wish more exercise.

6:00 p.m. Arrive back at Seaside Park. For some this may be later.

6:04 p.m. (Those participating Friday only leave Seaside Park for N. Y., change at Point Pleasant to Central R.R. of N. J. train, same track.)

8:35 p.m. (Those participating Friday only arrive New York, Liberty St. ferry.)

Saturday, June 27:

3:24 a.m. (Those participating all day Saturday only leave Liberty St. ferry N. Y. via Central R.R.N.J. Buy one ticket to Point Pleasant, $1.30. Get ticket there for Barnegat Pier and take P.R.R. train on same tracks 7:20, a 13 minute wait.)

7:45 a.m. Those participating the two days leave Seaside Park via P.R.R. for six mile ride, most of it across Barnegat Bay, to Barnegat Pier.

7:51 a.m. All hands arrive Barnegat Pier. There will be a walk of some five miles out to Beachwood.

11:00 a.m. (Anyone wishing to participate Saturday afternoon only may leave N. Y. Liberty St. ferry. Buy round trip ticket to Ostrom. Change at Lakewood to motor coach. Service is via Central R.R.N.J.)

12:00 noon Lunch at Beachwood.

1:12 p.m. Leave Beachwood via C.R.R.N.J. for Ostrom, fare 22¢.

1:37 p.m. Arrive Ostrom. There will be an easy walk with good bogs and upland pine barrens.

4:13 p.m. Leave Ostrom via C.R.R.N.J. motor coach for N. Y., fare $1.85. Change to rail service at Lakewood. Arrive New York at 6:30.

Note 1. Overnight lodging will range from $1.50 up. Meals according to appetite.

Note 2. Some may prefer to visit the State Game farm on Saturday afternoon. This is a short distance above Ostrom. Our motor coach passes there at 1:34 southbound and 4:16 northbound to New York.

Note 3. Connections may be made to Philadelphia from Toms River on the return Saturday afternoon in which case pay motor coach fare only to that point.

REGISTRATION

It will help materially, and assure you overnight accomodations, if the following information is available to the leaders as early as possible: How much of the trip do you propose to do? What time will you leave New York? Shall we reserve lodgings for you for Friday night? Do you have any preference about single, double, or other room accomodations? Anything else we can do?

John A. Small, Chairman, Field Committee

(Typeset unedited from the mimeographed program.)

1967

Barnegat Bay again—
June 27, 1942 and October 14, 1967

THE TORREY BOTANICAL CLUB

1967

Field Schedule

One Hundred and First Season

16

AUGUST

to Cross Bay Blvd. exit. Turn south (right) to Broad Channel, left at second traffic light to subway station, where all will meet. Leader: Herbert Kaltman.

27. (Sunday) U. S. Fish and Game Preserve, BRIGANTINE, N. J. A trip primarily for shore birds in the area. Meet at Leeds Grocery Store in Oceanville on U. S. Route 9, at 11:00 a.m. Bring lunch and bathing suit. Leader: Barbara Cook Kirsten.

SEPTEMBER

9. (Saturday) MOUNT KISCO, N. Y. Cornelia Van Rensselaer Marsh Memorial Wildlife Sanctuary. For fungi and flowering plants. Meet at Mt. Kisco Railroad Station, 11:23 a.m. Leaves Grand Central (upper level) at 10:15 a.m. Those with cars please meet at the station to pick up those arriving by train. Bring lunch. Leader: Leona Rem, Kitchawan Research Laboratory of the Brooklyn Botanic Garden, Kitchawan Road, Ossining, N. Y., (914) WI 1-8886.

10. (Sunday) PARVIN STATE PARK, Salem County, N. J. Some 355 species of vascular plants have been recorded in this 1025-acre park, including such southern species as Fringe-tree **(Chionanthus)**, Mistletoe **(Phoradendron)**, Poison Oak, **(Rhus Toxicodendron)**, and Virginia willow **(Itea)**. Meet at Park Office on N.J. 540, about 2 miles east of Centerton, at 10:30 a.m. Bring lunch. Suggested route from North Jersey: N. J. Turnpike to Exit 7, south on U.S. 206 to Hammonton, where it merges with N.J. 54, which follow to Buena. Here, take Wheat Road (unnumbered. but running due west) to N.J. 47, south on this about 1½ miles to N.J. 540, where turn right and continue to Park Office. It is about 60 miles from Exit 7, but with excellent high-speed roads. Leader: Louis E. Hand.

16. (Saturday) STATEN ISLAND, N. Y. Olmstead Trail, covering the section between High Rock Park and Richmondtown. Meeting place and time the same as for April 16th trip. Leader: Mathilde P. Weingartner.

17. (Sunday) BEAR MOUNTAIN, Harrim State Park, N. Y. A trip primarily to st composites. Meet at the parking lot at summit of Bear Mountain at 10:30 a.m passengers should plan to be waiting in of the Bear Mountain Inn at about 10:

17

SEPTEMBER

(consult bus schedules) where those with cars will pick them up for ride to parking lot at summit. Leader: Arthur Cronquist, The New York Botanical Garden, New York, N. Y. 10458.

22-24. (Friday-Sunday) AUTUMN CAPE MAY NATURE WEEKEND. The New Jersey Audubon Society cordially invites The Torrey Botanical Club to join them in field trips to observe the fall migration of birds through this area. There will also be boat trips. Natural history motion picture lectures will be presented by well-known wildlife photographers in the Cape May Convention Hall, Cape May, N. J. on Friday and Saturday evenings. Registration fee $1.50 for members of the N.J. Audubon Society; non-members $3.00, which includes lectures and all nature walks, except boat trip. Send registrations to New Jersey Audubon Society, 790 Ewing Ave., Franklin Lakes, N. J. 07417. For other information see announcement of the Spring Weekend, May 19-21.

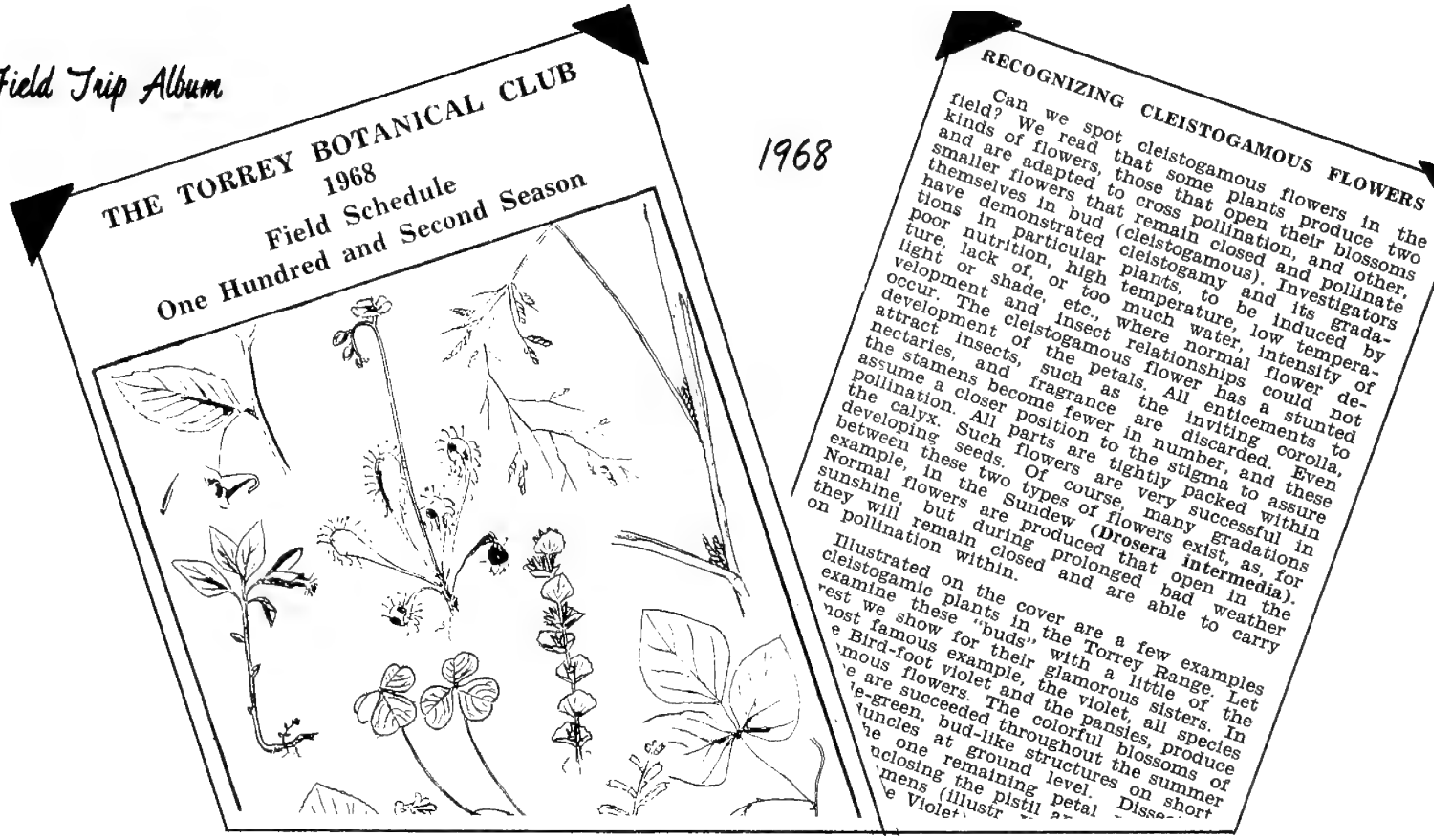
23. (Saturday) STATEN ISLAND, N. Y. For late fall grasses. Bring lunch. Meeting place and time the same as for July 1st trip. Leader: Robert C. Meyer.

24. (Sunday) MIANUS RIVER GORGE, Bedford Village, N. Y. For flowering plants and fungi. Meet at 11:00 a.m. at bus stop in the center of Bedford Village. Bring lunch. See travelling directions for May 14th meeting. Leader: Eleanor Yarrow, 2750 Olinville Ave., Bronx, N. Y. 10467. Telephone (212) OL 4-9446.

OCTOBER

1. (Sunday) STONY BROOK, N. Y. For fungi and higher plants. Bring lunch and meet at the Erie R. R. Station in Sloatsburg, N. Y. at 9:45 a.m. Buses to Sloatsburg stop near the station. Check bus or railroad schedules for exact times. Leader: Eleanor Yarrow.

14. (Saturday) BARNEGAT BAY, in vicinity of Island Beach State Park, N. J. for marine fauna and flora. The bay is being studied intensively prior to the activation of the Oyster Creek Nuclear Power Plant so that the effect of hot water from the power plant may be documented. Because of the gear needed, this trip is offered by advance registration only. Write to Mr. Jonathan Taylor, Dept. of Botany, Rutgers—The State University of New Jersey, New Brunswick.



The Torrey Botanical Club...Now

The Torrey Botanical Club is an organization of people interested in plant life, including professional and amateur botanists, students, and those who just like to get out into the country to study nature.

MEETINGS. Indoor meetings are usually scheduled for the first and third Tuesday evenings of each month from October through May, usually at Columbia University, Fordham University, or The New York Botanical Garden. The feature of each evening is a lecture of general botanical interest or the presentation of the results of original research by someone active in that area. Field meetings are scheduled for nearly every Saturday and Sunday from April through November. These involve more or less walking, and the meeting place may be a city park or any place of botanical interest within about 100 miles of New York.

PUBLICATIONS. *Bulletin of the Torrey Botanical Club*—established in 1870; bimonthly; contains reports of research in all phases of botany, and an Index to American Botanical Literature. *Torreya*—established in 1901 for the publication of shorter papers, notes of general botanical interest, reports of field trips, and obituaries; since 1946 it has been published as a special section of the *Bulletin*. *Memoirs of The Torrey Botanical Club*—a series of longer botanical papers and monographs which began in 1889; the numbers have appeared at irregular intervals as funds and material have been available; 22 volumes have been published.

MEMBERSHIP is open to all persons interested in any phase of botanical activity, in these classes: ANNUAL MEMBERS receive the *Bulletin of The Torrey Botanical Club* and notices of meetings, field trips, etc.; annual dues $8.50. STUDENT MEMBERS have the same privileges as Annual Members but as registered students pay annual dues of $5.00. ASSOCIATE MEMBERS receive notices of meetings and field trips, and reprints of the *Torreya* section of the *Bulletin;* annual dues $3.00. SUSTAINING MEMBERS (annual dues $15.00) and LIFE MEMBERS (one payment of $100.00) are accorded all the privileges of the Club, including all publications and notices.

Anyone wishing to become a member should remit dues (payable to Torrey Botanical Club), for the class of membership desired, to Miss Grace A. Dietz, Treasurer Torrey Botanical Club, c/o The New York Botanical Garden, Bronx, New York 10458.

[Editor's note. An annual subscription to the *Bulletin of The Torrey Botanical Club* costs $12.00, but an individual annual membership which includes the *Bulletin* and many other features and adventures is only $8.50.]

MRS. JOHNSTON is a botanical artist whose water-color portraits of flowers have been published in numerous books, including her own *Strange Visitor*, and in *Chronica Botanica, American Home* magazine, and *The Garden Journal*. She has written for *The Garden Journal* previously.

How Cycads Reproduce

By Edith Farrington Johnston

When in my early ignorance about southern plant life I consulted that useful little book, *Wild Flowers of Florida*, by Mary Frances Baker, I found the first species described to be a cycad, *Zamia*, called coontie-palm. It is not a palm. But it is a *coontie*, in the language of the aboriginal Indians, who called flour prepared from its root *kun-ti-hat-ki*, white bread.

In a very early edition of *Wild Flowers of Florida*, Mary Frances Baker says, "These lowly representatives of past ages somewhat resemble the ferns, but unlike ferns they bear large brightly colored seeds; they also resemble the palms, but, unlike them, they have no flowers in the more common meaning of that word, and their peculiar cones show a distant relationship to the pines. Their manner of reproduction is extraordinary . . ." and leaves it there. I cannot ignore that kind of statement. I had to learn all about this strange plant family, its history, its modern status, and its extraordinary manner of reproduction.

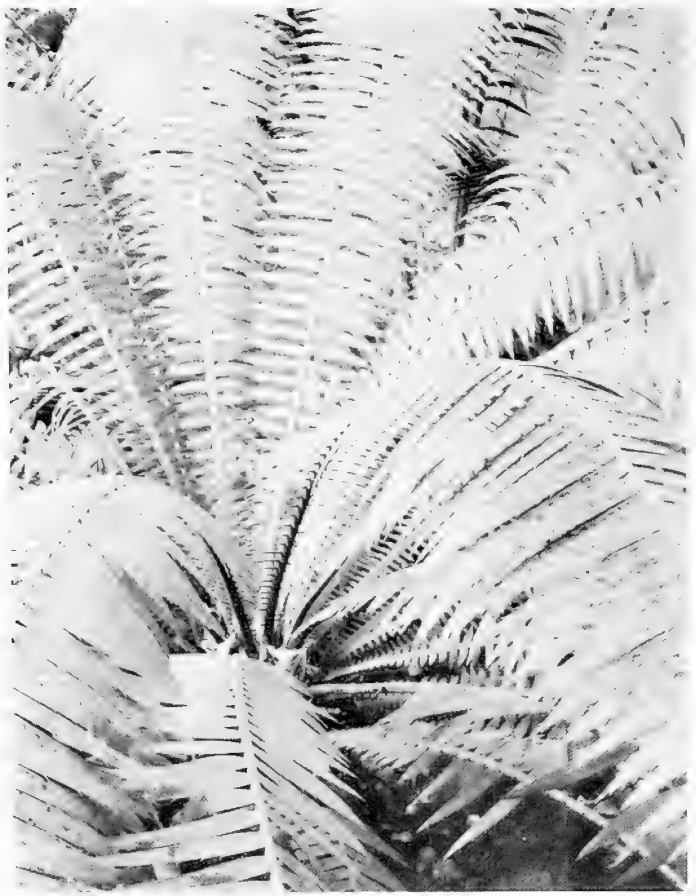
"'Their manner of reproduction is extraordinary.'"

Travelers to tropical or subtropical regions have undoubtedly seen some larger species of cycads, probably those grown in parks or in gardens open to the public. In Florida the low-growing coontie, with fronds springing directly from the earth in the manner of a fern, is common in both gardens and hammocks. For park and garden plantings the sago-palm, *Cycas revoluta*, its stocky trunk growing several feet above the ground and covered with leaf scars, is in high favor. Cycads, with their durable, rich, evergreen foliage and their immunity to bugs and blights, make most satisfactory plantings for southern parks and gardens.

A cycad plant consists of a stem, either above or below ground, surmounted by a crown of branching feather leaves that make it look like a palm; cycads are usually called palms by native residents. The name *cycas* is from the Greek word *kukas*, meaning "kind of palm." Some cycads, however, with their entire stem underground and with crowns of fernlike leaves, resemble the ferns (to which they are akin) more than they resemble palms. The most fernlike of all cycads is *Stangeria paradoxa* of Zululand, so called because it looks exactly like a great lush fern, leaf veining and all, but it is not really a fern, therefore a paradox. The flowering and fruiting parts of cycads are borne at the apex of the trunk, in the midst of the leafy crown, and are startlingly decorative.

The cycads differ sharply from all other plant families. Among gymnosperms, they share with the maidenhair-tree, *Ginkgo*, only, the curious development of ciliate motile sperms from their pollen. In flowering plants that have motile male nuclei, they move only by a sort of snakelike wiggling, whereas the cycad sperms propel themselves by the motion of many hairlike cilia. The cycads' ancestors are undoubtedly among the numerous ancient ferns that once prevailed over all the earth from the equator to the poles, and which, through countless ages of growth and decay, laid down the coal measures that are the basis of modern industry. The great order of Cycadofilicales or cycad-ferns were probably the immediate ancestors of those extinct cycads from which modern cycads are descended. When the cycad-ferns first appeared on the earth, back in the Triassic period of the Mesozoic age, the "Age of Cycads," no flowering plant existed anywhere on the steamy globe. There had been mammoth ferns and giant horsetails and lycopods, bearing their spores in

"...but it was at best a precarious business..."



Dioön spinulosum

(Photographs by Walter Singer)

Encephelartos villosus

spore cases on the backs or edges of their leaves, or on a specially developed spore-bearing stem. The true ferns set no seed. The fern seeds of the ancients consisted of the minute, viable spores that, given moisture and heat enough, developed into a fine green spatter, less like ferns than like moss, which when mature bore sperms and eggs. The sperms were water borne, and when by fortunate chance they fell upon the archegonia, their mating gave rise to another generation of ferns. This method of reproduction was good as far as it went, a notable advance, no doubt, over earlier methods. It is still practiced by the ferns of today. But it was at best a precarious business, depending on wind to blow the spores into a suitably wet medium for their development, and on water in the form of fogs, light rains, or heavy dews to provide a passage for the tiny sperms to the receptive eggs. The first experiments in a safer and surer method of reproduction occurred in the cycad-ferns of the Paleozoic era, which formed seeds much like those of modern cycads. Through countless ages of slow time these plants evolved into the true cycads, with their "extraordinary" manner of reproduction. Modern cycads strike a nice balance between the reproductive methods of ferns and those of flowering plants which appeared eons later.

In spite of their evolution from a lower to a higher means of reproduction, the cycads have become restricted to very small tropical and subtropical areas on the earth's surface and have decreased from a former abundant thirty-five genera to a modest nine. Their diminution has been effected largely by climatic changes that have transformed vast supertropical areas into cold regions, hostile to all but the smallest and toughest plant life. The world has become a much drier place, too, so that man, the Johnny-come-lately of creation, can scarcely conceive of the dense blanket of cloud and steam that must have kept those early tree-ferns and cycad-ferns in a state of near saturation. The fact that cycads exist at all today is proof of their toughness and adaptability.

"In the sixteenth century a certain unfortunate Spaniard . . ."

Cycads are of extremely slow growth. A Mexican species, *Dioön edule*, so named because its seeds provide the Mexicans with a tortilla meal, may have a stem only one foot in diameter and six feet tall and yet, according to scientists' best reckoning, be a thousand years old. Records were kept of the growth of two specimens of the African genus *Encephalartos*. One species, *E. altensteinii*, increased its height by one foot in forty-six years, but the other, *E. latifrons*, did not grow perceptibly in all that time, although its leaves were always fresh and green. It is this slow growth which makes

it unlikely that cycads could ever produce starch rapidly enough to make them of economic importance. Here and there we find the natives using the seeds to make meal or extracting the starch from the pith to use in laundry or kitchen, but the potential supply is too small to be widely used. The low-growing *Zamia*, the coontie-palm of Florida, seems to have the best record of all the cycads as a food producer. In the sixteenth century a certain unfortunate Spaniard, one Hernando de Escalante Fontanada, who lived for seventeen years as a captive of the Florida Indians, recorded that the aborigines "made bread of roots [*Zamia*], which is their common food in the greater part of the year." Before and during the Civil War many Negroes who fled to the Indians "were prevented from perishing of hunger by having recourse to it." It must, however, have been prepared for them by the Seminoles or others familiar with its use, as *Zamia*, like most cycads, contains a poison which must be removed by repeated poundings and washings, and by straining through a cloth. Soldiers during the Civil War are known to have died from the effects of eating the starchy root (stem) before the poison had been washed out. The leaves, too, contain a poison. Once the starch in the plant is properly processed, it makes a fairly palatable flour. "Arrowroot" biscuits are often made from coontie starch, though true arrowroot is obtained from a species of *Maranta*, a flowering plant.

Several species of columnar cycads are indiscriminately called sago-palms because of the sago-like starch prepared from their pith. The fact that they are not palms and do not yield sago makes no difference to those who call them so. True sago is derived from an East Indian and Malaysian fan palm, a true palm, *Metroxylon sagu*, and from others akin to it. Several of the cycads that are called sago-palms furnish edible seeds as well as the "sago" from their pith, and these seeds are commonly used for food by the natives of their habitats. But it is probable that even these inviting flame-colored seeds require a certain amount of preparation to remove the characteristic cycad poison.

Zamia is as common a dooryard ornament in Florida as was the patch of ribbon-grass in our grandmothers' front yards sixty years ago. Public parks and lawns all have a few coontie-palms, their leaves dark green and shining all year, and enlivened in spring by their circlets of slightly coiled, fernlike, pale young shoots. Hidden in the dark leafage, but on separate plants, are the dark brown cones, the male long and slender, the female short and thick. In midwinter the ripened female cones disintegrate, spilling a lapful of orange-scarlet seeds shaped like firm small dates.

The manner of this disintegration is most interesting. Each scale of the female cone has been modified into a slightly convex six-sided plate. Twin seeds cling to the inner surface of each plate, and the plate itself is anchored to the axis of the cone by a stout pin or peg about an inch long. As the seeds swell to maturity, they gradually force the pins out of the axis so that the entire cone falls apart and lets the bright seeds lie on the ground. They should germinate there, and doubtless they do in the wild hammocks, but in gardens I have never seen any young coontie-palms which I could, with assurance, call seedlings.

The two columnar cycads most used horticulturally, *Cycas revoluta* and *C. circinalis*, are members of a genus that extends from Japan to Australia. The durable, stiff, dark green leaves are much in demand for use on Palm Sunday, for funerals, and for placing—fresh or in sculptured representation—upon monuments to the illustrious dead. When next you see crossed palms on a hero's memorial, or paintings of the strewing of palm branches in the road before the ass's colt ridden by Christ on His triumphal entry into Jerusalem, you will be seeing not palm branches but fronds from the leafy crown of one of these cycads. When mature these leaves, though of a brilliant metallic green, become tough and leathery; because of their peculiar internal structure they lose very little moisture from their tissues so that they may remain bright and green for a week or more after cutting.

"When next you see crossed palms on a hero's memorial . . ."

As I have said, the cycads occupy an intermediate position between flowering plants and ferns. They form seeds much like those of the flowering plants. But in the formation of distinct, complex male and female bodies within the ovules and in the details of sperms and eggs they resemble ferns. Cycads are dioecious, that is, they have the two sexes in two separate plants, a male plant and a female plant.

The male cone is long and erect, varying in length from three or four inches in *Zamia pygmaea* to two feet or more in some of the columnar cycads. This cone is made up of a great number of modified staminal leaves which bear on their undersides globose pollen sacs arranged in groups of five, four, and three in the more primitive genera, as *Cycas* and *Dioön*, and three, two, or even a single one to a group, as in *Zamia*, the most modern form. These pollen sacs correspond to the microsporangia of some ferns, that is, the spore cases from which come the spores that will become sperm-bearing prothallia (pre-plants). (In most ferns, sperms and eggs are borne on the same prothallium, although not necessarily so.) As the cycads have progressed evolutionarily to a higher reproductive level, they have tended constantly to reduce the number of

spore cases in a group and the number of groups to each scale of the cone. This custom of bearing an infinite number of spores on the backs of modified leaves is the old conservative spore-bearing system of the ferns.

The female cone is in the form of an aggregation of carpellary leaves modified, in varying degrees, from the rather loose cabbage-shaped nest of the genus *Cycas* to the hard, velvety, maize-ear-like cone of *Zamia*. The margins of these leaves are coarsely toothed and on their edges are placed the naked ovules, which correspond to the megasporangia of some ferns, that is, the spore cases bearing spores which will grow into prothallia bearing egg cells. *Cycas* is the only genus in which male and female cones differ greatly in appearance, except in size. In *Cycas* alone the reduced carpellary leaves, which bear the ovules, are not crowded into a compact cone but are assembled into a large, fur-lined, cabbage-shaped nest surrounded by overlapping series of fawn-colored, furry, deeply notched leaves, each tip ending in a sharp spine. Inside this globular nest lie the resting ovules, two or three or four to a leaf, and within this nest the flame-colored seeds ripen and grow to the size of hen's eggs. Scrape away the heavy felted fur on the upper and lower surfaces of the carpellary leaves and you will find that they are true leaves, fleshy in texture, bright grass-green without and deep golden yellow within. *Cycas* is still close enough to its primordial fernlike ancestors to show at a glance its resemblance to those early forms from which modern cycads are derived, and to show the derivation of carpellary leaves from green vegetative leaves.

"Cycas is the only genus in which male and female cones differ greatly in appearance . . ."

As the male cone develops, the pollen grains slowly mature. When their development has reached the stage where they must leave the spore cases, the axis of the cone grows longer, pulling apart the scales allowing the ripe pollen to easily escape, to be wind-borne to the female cone—and everywhere else, too!

In the female cone, which matures at the same time, the naked ovule on the margin of the carpellary leaf is the equivalent of the megasporangium of some kinds of fern. But it is more than that—it is the future nursery and food source of the developing sperms. The megaspores do not fall out as do the microspores. The megaspore germinates within the spore case, inside the ovule, and the resulting prothallium (pre-plant) does not grow out and become green, as it does in most ferns, but remains within the spore case, inside the ovule, where it looks like a part of the tissue of the ovule itself. This little pre-plant, when mature, will bear the eggs, or female cells, of the cycad.

The nucleus of the egg cell is the largest of all plant nuclei. It is this system of retaining the megaspore and its resultant female prothallium within the spore case that constitutes the difference between the flowering plants and the ferns. This progress in manner of reproduction is confined to the female plant. Among plants generally, male structures are more conservative than female, so the persistent fernlike behavior of the pollen, as distinguished from the seed-plant behavior of the ovule, only illustrates a state of affairs common in the plant world.

When the male cones are shedding their pollen, the scales of the female cones loosen and separate slightly so that the pollen may sift in upon the waiting ovules—this is pollination. And here occurs one of the most extraordinary facets of this extraordinary manner of reproduction. As the pollen grains drift down, a group of cells at the tip of the ovule breaks down and secretes a clear syrupy droplet. The breakdown of these cells has resulted in the formation of a minute hollow beneath the shining drop, and it is into this pollen chamber that the pollen grains are drawn as they fall upon the droplet at the ovule's tip. Development of the pollen grain in the pollen chamber goes on for several months before sperms are finally formed by the male prothallium or mating plant. All this while, the pollen tube formed from the pollen grain acts as a parasite within the ovule, sucking food from its nutrient tissues as it grows. Charles J. Chamberlain says: "The details of spermatogenesis and sperms are more complex in cycads than in any other group of plants or in animals."

"And here occurs one of the most extraordinary facets of this extraordinary manner of reproduction."

As the tissues within the ovule are consumed, the pollen chamber gradually stretches out until at last the pollen tubes reach the female pre-plant, now approaching its own sexual maturity. The sperms mature rapidly and develop the cilia which make their vigorous motion possible. For some hours they swim about in the pollen tube, first sluggishly then with increasing momentum, until at last the tube ruptures, a liquid drop spurts out, and the first sperm breaks free. Then, by means of a mechanism almost too elaborate for belief, the sperm is drawn into the neck of a sort of sack which contains the egg, situated at the tip of the female pre-plant. Slipping out of its sheath and shedding its spiral band of cilia, the nucleus of the sperm unerringly seeks out the nucleus of the egg, makes contact with it, becomes embedded in it. The marriage is consummated; fertilization has taken place.

The long interval between pollination and fertilization, as much as seven months in some species,

Stangeria paradoxa, female plant

Zamia floridana. (Photograph by Gilbert Hughes III, from *Introductory Botany* by Arthur Cronquist.)

is a curious feature of cycad reproduction, but one not unknown among plants. Among the pines more than a year may elapse between the falling of the pollen and the fertilization of the egg cell; in oaks it is even longer. But to the student of flowering plants, with their brief period of hours or days between pollination and fertilization, it seems an incredibly long time. The resulting offspring is, of course, the embryo cycad plant inside the brightly colored seed with its store of nutriment and that element of poison common to cycads.

The seedling cycad shows but one leaf, small and having few leaflets, at first. It is some weeks before even one more leaf appears. Cycads are deliberate in all things. Little by little, more single leaves appear, until after five or six years, the first small crown, perhaps only two or three leaves, stands forth. Each succeeding crown will show more and larger leaves, with more leaflets, until the number usual with the species has been attained.

"Cycads are deliberate in all things."

There is little regularity about the production of either leaves or cones. In hot, dry, windy habitats, where the foliage suffers much damage, new crowns are produced as often as necessary, sometimes two in one year; hothouse specimens or other protected plants may wait two years between crowns. The production of the great cones appears to exhaust the plant to some extent, so that it may rest for a year or more before putting forth another crown of leaves and several years before producing another cone or group of cones.

Cones of some of the tropical species are surprisingly large. *Dioön spinulosum* of Mexico bears female cones twenty inches long, weighing as much as thirty pounds, each with two to three hundred large seeds; these are used to make tortilla meal as are those of *Dioön edule.* Female cones of the genus *Encephalartos* are huge, and a large plant may bear two or three at a time. One plant was recorded as bearing three large cones with a combined weight of ninety pounds, the largest cones reported for any plant. What becomes of all this lavish abundance of starchy food? Baboons keep watch of the developing cones and eat the seeds shortly before they ripen. Apparently the cycad poison is weak in *Encephalartos,* or the baboons are immune to its effects. Male cones are much smaller; a weight of ten pounds is extreme.

In cycads, as in many plant families, sexual reproduction is not the only means of propagating the species. New cycad plants may develop, and usually are developed horticulturally, from buds formed wherever a portion of the stem is wounded. Branching may be induced by wounding the stem wherever a branch is desired. This method is commonly used with the specimens of *Cycas revoluta* cultivated in Japanese gardens and temple grounds. Apparent branches are often formed on female plants by the sprouting of seed in the nest created within the enclosure of the leafy crown by the decay of the female cone. The seeds thrust roots into the soft tissues of the developing leafbud and establish themselves there, often several in a colony. But these methods are fortuitous and not to be depended upon. For all-around, "sure-fire" carrying on of the species, the cycads have evolved their own complex and interesting manner of sexual reproduction. ■

"... the cycads have evolved their own complex and interesting manner of reproduction."

Health-Related Research at The New York Botanical Garden

By William C. Steere
Director, The New York Botanical Garden

It comes as a surprise to many people to learn that much of the research conducted by The New York Botanical Garden is health-related, with a very real potential for bettering the health and welfare of mankind. In fact, several long-term programs of basic research on the botany, microbiology and biochemistry of natural products of fungal metabolism (or fermentation) are supported by the National Institutes of Health (more than $175,000 was granted to us for this research during 1967). One of the questions most frequently asked by friends and visitors concerns how much "cancer research" is being carried on in the laboratories of The New York Botanical Garden, to which the only honest answer is "none." The expression "cancer research" is overused and overstressed by some institutions to glamorize or to justify basic research—or to raise funds; such use of the phrase is too often pretentious.

Diseases of both animals and plants will never be conquered by a study of symptoms alone, but only by investigation of the basic underlying causes of the diseases. Though the differences between basic science and applied technology tend to be somewhat hazy, the fields of medical research furnish many outstanding examples of both. Cancer is a terrible disease, to be sure, but it is the expression of an underlying cause, not the cause itself, and its cure will eventually—and inevitably—be discovered in some laboratory doing basic biological, microbiological or biochemical research.

For one of the earliest and most dramatic examples of the discovery of a cure for disease through basic research, we must go back more than a century. During the eighteenth and early nineteenth century many wars were going on simultaneously, and many casualties resulted. In those days, bacteria were known to exist, but their relation to infection and disease had not yet been suspected. Consequently, as there was no knowledge of antiseptics or real cleanliness, even the slightest wound tended to become infected and much too frequently to cause thereby the loss of an arm or a leg—or of life itself. In the many dramatic paintings showing Napoleon's retreat from Moscow in 1812, one cannot help but observe the disproportionate number of soldiers who have lost one or more limbs. In fact the ratio between injury and death was much higher in those times, and bacteria probably killed more soldiers than bullets did. This problem finally became so serious that in England, during the Napoleonic wars, medical men formed a society for the study of pus, so prevalent in battle wounds. However, the study of pus formation in wounds in those days was relatively ineffective, as the solution to the problem was to be found eventually in the results of basic and quite unrelated research. (We may draw an apt parallel with "cancer research" today!)

Louis Pasteur began his scientific work as a chemist with the investigation of several basic problems, some of them of immediate economic application. For example, a problem of especial economic importance in France concerned the how and why of the souring and spoiling of wine. After many trials and tribulations in investigating this age-old problem, Pasteur discovered that the original sugars present in grape juice were transformed into alcohol by the vital activities or "fermentation" of living yeasts, which occur very generally on grape skins. He also discovered that living bacteria introduced through carelessness or lack of cleanliness could cause other and undesirable transformations, also

by means of their life activities. For example, bacteria change alcohol into acetic acid and thereby sour the wine, and they produce other substances that impart "off" and "spoiled" flavors and odors to the wine, a matter of very considerable economic importance. Through further experiments, Pasteur discovered that by heating the grape juice or still-unfermented wine to a certain point, he could rid it of most bacteria, yeasts and other living microorganisms without damaging the value of the wine eventually produced after inoculation with a highly desirable yeast. Almost all Americans are thoroughly familiar with Pasteurized milk as a way of life, but very few of them (perhaps because of Mr. Volstead!) are aware that the process was first developed for wine and only later adapted to milk.

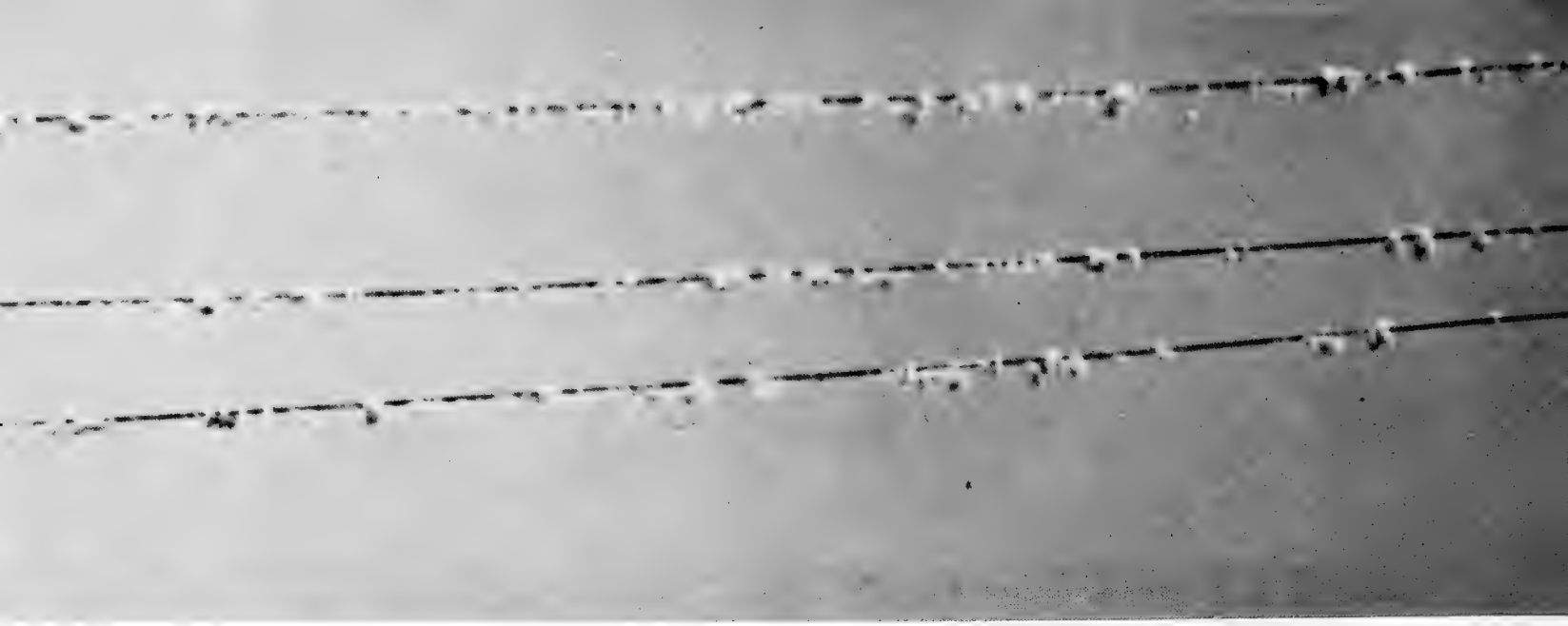
Pasteur's inspired idea that bacteria might also be responsible for infections and diseases of man and his domestic animals was convincingly proved by his experiments on sheep and chickens with the bacillus that causes the usually fatal disease anthrax in animals and occasionally in man. Pasteur's discoveries, all resulting from basic scientific experiments in microbiology and chemistry, revolutionized medical practice. The medical profession's realization, finally, that the presence of bacteria in wounds was the *cause* of pus resulted in the development of measures to prevent infection in the first place, by the sterilization of wounds, of surgical instruments and of dressings, in order to rid them of bacteria. But who, even today, could have predicted that the cause of pus and morbidity in wounds would be discovered through basic research devoted to the souring of wine?

The history of many other great discoveries and breakthroughs in medical research parallels that of Pasteur's discovery. The symptoms themselves give very little indication of fundamental causes, which may be extremely obscure, and may have to be discovered quite by happy accident, or serendipity. For example, basic research on toxins and antitoxins was eventually applied and found extremely useful in the treatment of many diseases and conditions. The development of anti-poliomyelitis vaccines by Jonas Salk was largely a technological breakthrough made possible by the application of the results of extensive basic research on immune antibodies by John Enders and others—research that has been carried on for decades.

Over the years, basic research has been far more efficient and effective than clinical research, since it is more likely to produce fundamental truths that have an impact on several or many diseases, and not just on the symptoms of one. Finally, since basic experimental research must precede the discovery of the cause and control of any disease of plants and man, our emphasis at The New York Botanical Garden must be on this approach and not on so-called "cancer research." ■

Louis Pasteur in his laboratory.

In the microbiological laboratory of The New York Botanical Garden's Research Laboratory, Ina Wong and Laurie Bloswick assist Dr. Annette Hervey in an investigation of the nutrition of fungi.



Usnea species on wires at Mountain View, Island of Hawaii, January 20, 1967. (Photo by R. Wakida.)

Lichen-Covered Electric Wires in Hawaii

By Otto and Isa Degener and William MacKenzie

Lichens are complex plants of a dual nature, consisting of a fungus and either a green alga (Chlorophyceae) or less commonly a blue-green alga (Myxophyceae). Hence, a lichen is a consortium (in Hawaii, a *hui*), in which the two distinct kinds of organisms live symbiotically or in close association for their mutual benefit. Neither fungus nor alga alone could survive under many of the circumstances that are suitable for them when they are combined as lichens. As the earliest lichenologists knew, various kinds of lichens can grow and survive on practically anything. They grow on bare rock, bark, leaves, sterile ground; even on substrata not ordinarily expected to support any plant, such as iron, glass, bone, leather, newspaper, animal excrement, living mollusks, and the rough backs of certain large New Guinea beetles. As early as 1883 in his "Etude sur les Substratums [sic] des Lichens" Richard gave an imposing list of such unusual places on which lichens could grow. Nowhere in lichen literature, however, have we come across a report that a lichen will live—as do some tropical American Bromeliaceae—on electric wires.

In May 1966 we [the Drs. Degener] rented a cottage at "29 Miles," Volcano, Puna, Island of Hawaii, about 3900 feet elevation. On three sides of the cottage were *Metrosideros* trees and *Cibotium* tree ferns; the fourth side was clear of vegetation but telephone and other utility wires ran between the house and a pole at the side of the road. We were attracted by a pale lichen growing in scattered fashion on the electric wire, although the telephone wire was bare. The dependent lichen was an interesting sight, stiff in the morning sun and flexible with the coming of clouds in the afternoon. With some difficulty, we scraped against the wire with a broom held at arm's length. A few of the stubbornly attached lichens finally dropped to the ground. These were airmailed to the lichenologist Oscar Klement in Leutkirch-Eisenbach, Bavaria. Dr. Klement identified the plant as the endemic *Usnea hawaiiensis*.

Because it was difficult to collect enough of this beard lichen for study, we solicited help from Mr. William MacKenzie, manager of the Hilo Electric Light Company. He procured, for study, a five-foot length of wire covered with 343 individual lichens. Electrical engineers know this wire as triple-braid weatherproof copper wire. It is solid copper No. 6 AWG insulated with woven or knitted braids saturated with high-melting-point asphalt and finished with a mineral-filled coating material such as pitch or asphalt; the braids are then coated with mica flake. We sent the wire to Dr. Klement, who noted not only the yellow-green *Usnea hawaiiensis* growing on it but also the gray-green *U. poliotrix*. The latter, a Central and South American lichen, had never before been recorded from the Hawaiian Islands. Besides these two lichens, the wire harbored some blue-green algae that appeared to be *Scytonema* or some related genus.

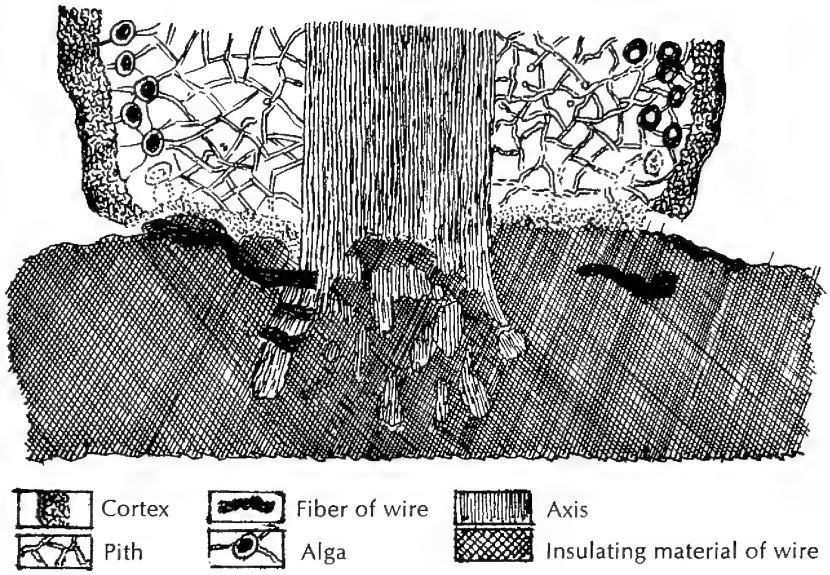
Dr. Klement's drawing shows that the lichen haustorium (the anchoring organ) with strengthened, interspersed hyphae strands (individual filaments) penetrates only a quarter of a millimeter into the insulation, though in pulling it free the penetration

seems much deeper because the strands are so intimately intertwined with the fabric that the latter tears out with them. No wonder we had so much difficulty freeing the lichens from the wire with sweeps of a broom!

We did not observe *Usnea* on bare copper electric wires which ran parallel to the telephone wires; as yet, the reason for its absence from the bare wires is not clear. Many lichens, particularly crustose kinds, can grow on copper, so we suspect our *Usnea* is not poisoned by this element nor by its oxides. Perhaps the bare copper wire is too smooth for lichen propagules to attach themselves to it, particularly as moisture tends to drop or dry off and not linger as on the fabric-covered wire.

While driving along the "Belt Road" of the Island of Hawaii we observed *Usnea* growing on older but similar covered wires at about 1000 feet elevation *makai* (oceanward) of Kurtistown to about 4000 feet in Hawaii Volcanoes National Park. As the elevation, and consequently the moisture content of the air, decline in the District of Kau just beyond Park Headquarters and in the District of Kona, usneas do not grow on the wires. In the approach to Waimea (Kamuela), where rain and fog drive through the gap made by the Kohala mountain mass on one side and Mauna Kea on the other, the lichens appear in particular profusion.

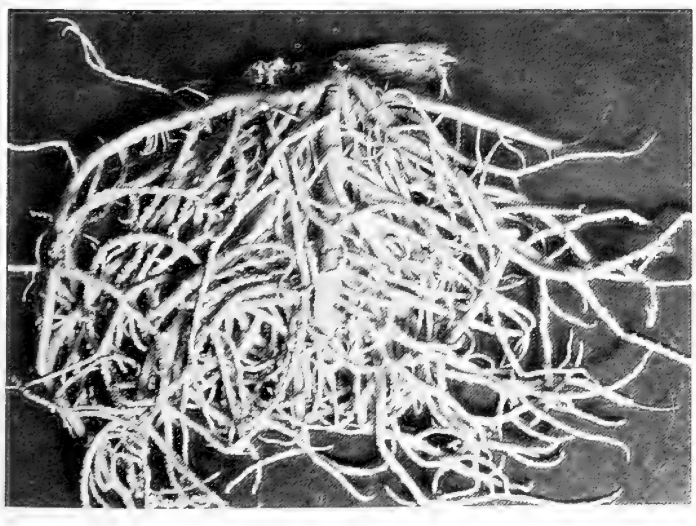
Old lichen-covered wire apparently loses none of its efficiency in transmitting electricity. The lichen, however, is a nuisance in humid weather because its drenched body increases the wire's weight and causes it to sag between poles; in windy weather, the lichen catches the breeze and the wire swings back and forth, perhaps into tree branches. Hence this picturesque sight of pale lichens hanging from black wires is becoming increasingly rare—this wire is being gradually replaced by neoprene- or polyethylene-coated copper or aluminum wire, which apparently does not furnish the proper moist foothold for lichen propagules. ■



Usnea hawaiiensis — longitudinal section showing penetration of haustorium into fabric of wire. (Drawing by O. Klement.)

Dr. Otto Degener, a New Yorker familiar with The New York Botanical Garden since childhood, moved to the Hawaiian Islands in 1922. He taught Botany at the University of Hawaii, was a Naturalist at Hawaii National Park, then a botanical consultant and author. In 1933 he became Collaborator in Hawaiian Botany of The New York Botanical Garden, resident in the Islands. In 1940-41 he was the botanist on Mrs. Anne Archbold's Cheng Ho Expedition to Fiji, where he collected a distant relative of our buttercup and magnolia so outstanding in primitive features that it became the type of the new family Degeneriaceae. Dr. Degener was awarded the Linné Medal by the Royal Swedish Academy of Sciences for his researches in the Pacific. Dr. Isa (Mrs. Otto) Degener was born in Berlin, Germany. She engaged in taxonomic research and taught Pharmacology at the Free University and the Botanical Garden and Museum in Berlin-Dahlem. Upon her marriage she joined her husband as co-author of *Flora Hawaiiensis or New Illustrated Flora of the Hawaiian Islands*, a work now in its seventh volume. The Degeners have contributed about 28,000 sheets of Pacific Island specimens to the Britton Herbarium at The New York Botanical Garden since 1922. William MacKenzie, part-time rancher and resident of Volcano, Island of Hawaii, is Manager of the Hilo Electric Light Company.

Yellowish-green *Usnea hawaiiensis*. (Photo by H. Ullrich.)



Usnea species on wires at Puukapu, Waimea, Island of Hawaii, January 16, 1967. (Photo by R. Wakida.)

When we enquire into any subject, the first thing we have to do is to know what books have treated of it. —SAMUEL JOHNSON

Book Reviews

FLOWERS OF THE BRAZILIAN FORESTS

By Margaret Mee. 144 pages, folio (20⅞ by 15⅜ inches) multicolor illustrations; indexed. The Tryon Gallery Ltd., 41/42 Dover St., London W.1, England (in association with George Rainbird), 1968. 100 guineas ($252).

This magnificent folio book, produced under the patronage of the Duke of Edinburgh, is probably well beyond the means of most people with a deep and abiding interest in plants (as well as of some institutions!), yet a review of it nonetheless deserves space here to the extent that the importance of this book as a publishing landmark dictates. Centrally, it consists of 32 well-executed and beautiful folio color plates, each devoted to a different kind of flowering plant collected and painted by Margaret Mee in Brazil. The text for each plate includes a technical description of the plant by a reputable botanist, supplemented by Margaret Mee's fascinating and often dramatic account of the place and circumstances in which she collected it. Also, her attractive black-and-white vignettes show the form of each individual plant as it grows naturally; the number of each plate is keyed to the place of collection on a two-page map.

Sir George Taylor, Director of the Royal Botanic Gardens, Kew, has provided an appreciative preface and Roberto Burle Marx, an outstanding Brazilian landscape architect widely famous for his use of tropical plants for mass and color, has contributed a perceptive essay on the Brazilian forests as an introduction. The botanical specialists who wrote descriptions of the various plants illustrated are Dr. Bassett Maguire, The New York Botanical Garden; B. L. Burtt, Royal Botanic Gardens, Edinburgh; Dr. Richard S. Cowan, Dr. Lyman B. Smith, and Dr. John J. Wurdack of the Smithsonian Institution, Washington; Luiz Emygdio de Mello Filho, Museu Nacional, Rio de Janeiro; David Hunt, Royal Botanic Gardens, Kew; Guido F. J. Pabst, Herbarium Bradeanum, Rio de Janeiro; Reverendo Padre Raulino Reitz, Herbário Barbosa Rodrigues, Itajaí; and Dr. André Robyns, Jardin Botanique, Brussels.

Although a note by the publisher, Aylmer Tryon, acknowledges that Dr. Alcides Teixeira, Director of the Instituto de Botânica de São Paulo was "associated with the book from the beginning," it does not make clear that a majority of the plates were actually painted in his institution.

In addition to its great aesthetic beauty and enormous attractiveness, this book also has considerable botanical importance as can be seen from the description and illustration in it of three new species: *Catasetum meeae*, an orchid described by Guido F. J. Pabst (Plate 16), *Neoregelia margaretae*, a bromeliad described by Dr. Lyman B. Smith (Plate 25), and *Spathiphyllum grazielae*, an aroid described also by Dr. Smith (Plate 31). The first two species are named in honor of Margaret Mee and the third for Doctora Graziela Maciel Barroso of the University of Brasília.

For specifics, the book consists of 144 pages, 20⅞ by 15⅜ inches trimmed, including 32 plates (one as frontispiece) in 6-color-separation lithography, 38 pages of text and 32 vignettes; title page and two-page map in two colors; printed on excellent heavy paper; binding blocked in real gold; top gilded. This book was issued in two versions. A special edition with an original drawing signed by the artist is bound in full vellum, in a buckram slipcase. Of this special edition, copies lettered A-F are not for sale, being produced for the artist and her friends; copies 1-100 were priced at 175 guineas ($440) but are already sold out. The standard edition (copies 101-500) is bound in quarter morocco with hand-marbled paper sides, vellum tipped, in a slipcase, and is priced at 100 guineas ($252). The book was designed and produced by George Rainbird of London for the Tryon Gallery, but was actually printed in the Netherlands.

—WILLIAM C. STEERE

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Members of The New York Botanical Garden will receive a discount on books they order (including those reviewed in the GARDEN JOURNAL) that deal with plants, such as books on botany, horticulture, conservation, ecology, indoor and outdoor gardens and gardening, particular kinds of plants, natural history, and texts.

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SPECIAL PROCEDURE FOR ORDERING "WILD FLOWERS OF THE UNITED STATES": Send orders (WITH REMITTANCE payable to The New York Botanical Garden) for "Wild Flowers of the United States" by Harold William Rickett to MEMBERSHIP SECRETARY, The New York Botanical Garden, Bronx, New York 10458. Members' special prices are: Volume 1—Northeastern States, $36.00 including shipping plus $1.75 New York City sales tax OR plus 70¢ New York State sales tax. Volume 2—Southeastern States, $40.00 including shipping plus $1.95 New York City sales tax OR plus 78¢ New York State sales tax.

A NATURALIST IN RUSSIA. LETTERS FROM PETER SIMON PALLAS TO THOMAS PENNANT

Edited by Carol Urness, 189 pages; indexed; illustrated. University of Minnesota Press, Minneapolis, 1967, $7.50.

When he was only 26 years old, the dedicated German naturalist Peter Simon Pallas was invited by Catharine II to accept an important position in the Academy of Sciences in St. Petersburg; he remained in Russia for 43 years. Within a year of his arrival in St. Petersburg, Pallas set off on a great scientific expedition to Asiatic Russia that was to last for six years (1768-1774) and bring everlasting fame to him and to his adopted country for his zoological and other scientific studies. He was one of the first naturalists to reach Lake Baikal and still further eastward to the border of Mongolia. Pallas' second great exploring trip was through the Crimea (1793-1795), where he retired with the permission of Catharine II. Although primarily a zoologist, Pallas also published a flora of Russia; he was deeply interested in many further branches of science. His drawings of plants in the present volume show him to have been an acute

and perceptive observer of all natural objects. In fact, his illustrations have a certain timelessness that contrasts strangely with the formal style and peculiar spelling of his letters—and of the age; my only quarrel with the illustrations is that they are used in this handsome book largely as ornaments and not with any central purpose, so that one has to refer to a table in the back to find out what each one represents. Aside from the odd format, this is an interesting, useful, and attractive work that fills an important gap in our information about Pallas.

—WILLIAM C. STEERE

IN THE NAME OF SCIENCE

By H. L. Nieburg. 431 pages; indexed. Quadrangle, Chicago, 1967, $7.95.

This is an exposure book. It is largely devoted to elaboration of the warning contained in President Eisenhower's farewell address about the power of the industrial-military complex in the United States. The author brings to his work a passion uninhibited by objectivity. Although he is a professor (Associate Professor of Political Science, University of Wisconsin), he exhibits no love for his colleagues, and quotes Robert Hutchins: "... professors are somewhat worse than other people, and ... scientists are somewhat worse than other professors." In fact, to use racetrack terms, Professor Nieburg intellectually is by Hutchins out of Rachel Carson.

In many ways *In the Name of Science* resembles a miracle play. It might even end up on Broadway as a musical —stranger things have happened. It has a plot, several villains, a hero and some sub-heroes. The program might look like this:

VILLAINS. *NASA:* "Americans have never been convinced of the high priority granted to space in their own country." "The drag race to the moon has not yet lost its nationalistic flavor." *AIR FORCE:* "We recognize the dependence of the Air Force on the aircraft industry." "Almost three years had gone into denying Air Force claims to being a fourth branch of government." *CORPORATE GIANTS:* "The dominant centers of corporate power have largely usurped the government's evaluation and technical direction responsibilities." *CONTRACT SYSTEM:* "As a matter of fact, the federal government now supports nearly 70 per cent of all research and development being done in the United States today." "Research by private industry has been rapidly tapering off." *SCIENTISTS:* "The word 'science' has acquired ... a highly authoritative quality whose unmistakable halo effect is borrowed by many different self-serving groups." "Scientific man is not necessarily any more 'intelligent' than his unscientific brethren." "The words 'science' and 'technology' have joined the lexicon of 'God' and 'motherhood' as self-evident eternal verities." "... science had become not a great boon but an enemy of man." *BANKING GROUPS:* "... have for years been pushing for higher interest rates and tighter credit." *POLITICIANS:* "The political process has a remarkable tendency to learn from experience by substituting new errors for old." *PATENTS:* "Today patents afford small business or individual inventors little or no protection." *COMSAT:* "A child of the economics of ambiguity, Comsat was born and raised in controversy."

HEROES. *McNAMARA:* "Under Robert McNamara, the Department of Defense has attempted to subordinate military ambitions to independent civilian judgment." *GAO:* "The U. S. General Accounting Office has been an effective source of auditing data apprising Congress, the administration, and the public of the abuses of the Contract State."

If controversy generates readership, this book should have a good sale. The author paints a gloomy picture of the American scene. He criticizes the enterprise system for turning the affluent society into the effluent society. He does not mention that this affluence has enabled the United States to distribute over 100 billion dollars to less fortunate countries since World War II. Nothing is said of the huge private donations by our private citizens for health, education, and welfare. That Americans are beginning to use their affluence to finance a cultural explosion is also not mentioned.

Nevertheless, *In the Name of Science* will make a contribution if it provokes thoughtful discussion of our national goals. Amidst a welter of exposure of the evil deeds of the villains, the author plays upon certain themes: Man is destroying his environment. We are not making the best use of our limited resources. Increasing subsidy of industry and education by the federal government through the contract system leads to abuse. New management techniques are necessary both in business and government because of the increasing size of organizations: Secretary McNamara is attempting to apply them against the opposition of "special interests." Man's knowledge of the physical sciences has increased enormously, but his wisdom and knowledge of the humanities and social science (if it is a science) have not kept pace.

That these are all matters which deserve our serious attention goes without saying. Whether or not you agree with Professor Nieburg's conclusions, I think you will find his book readable and interesting.

—CHARLES B. HARDING

THE SMITHSONIAN: OCTOPUS ON THE MALL

By Geoffrey T. Hellman. 224 pages; indexed. Lippincott, Phila., 1967, $5.95.

"Most of the material in this book originally appeared in *The New Yorker,* in a slightly different form," we learn from the dust jacket of this fascinating book—but every Geoffrey Hellman fan knew that already. This book tells the story of the Smithsonian Institution in highly personal terms—and often the very words—of the people who have shaped and guided its development since the beginning. No book this size could possibly give the complete history of an institution as old, as vast, and as complex as the Smithsonian is today, so that a sampling technique had to be used; however, the samples are anything but random and, on the contrary, are enormously well selected. Through enlightening and often amusing anecdotes, illustrative quotations from the published literature, and verbatim interviews—all skillfully woven together with the author's own perceptive evaluation of people and events—we are enabled to see, hear and understand the many individuals who have brought about the gradual evolution of the Smithsonian to its present position of world leadership. No other contemporary writer can transmit more information more painlessly or with greater subtlety than Geoffrey Hellman. Even the casual reader who resists new ideas and information most stoutly will have to admit after finishing this book that he knows far more about the Smithsonian than he had originally planned or deemed possible, just because he had so much fun reading it.

—WILLIAM C. STEERE

THE GARDENS OF WINTERTHUR IN ALL SEASONS

By Harold Bruce. 196 pages; illustrated; indexed. Viking, New York, 1968, $12.95.

This beautifully produced book about one of America's great gardens sets out to describe the many different facets of Winterthur. The superb illustrations underline the vision and taste shown by Henry Francis du Pont, the designer of Winterthur, in introducing many rare and colorful plants into the natural surroundings of his estate to create not only a great plant collection but a garden. Both the full-color and the black-and-white photographs of individual plants and schemes are truly superb and convey some of the thought and imagination that have gone into the making of this garden for all seasons.

It is to me unfortunate that the author, by using so much repetitive and often irrelevant detail in his descriptive tour, tends to confuse rather than explain. In summary: a superbly illustrated book marred (but not entirely ruined) by an overdescriptive text.

—DENNIS A. BROWN

AIRBORNE MICROBES

Edited by P. H. Gregory and J. L. Monteith. 385 pages; illustrated; indexed. Cambridge University Press, New York, 1967, $13.50.

This symposium volume reports the discussions on aerobiology by 22 English and American scientists at a meeting held in London in April, 1967. Physical and biological aspects of airborne microbes, particularly their dispersal, were considered by specialists in the fields of engineering, physics, meteorology, microbiology, mycology, botany, phytopathology, medical pathology, agriculture, and aeroscience.

Especially worthwhile reading are the chapters on liberation mechanisms of fungi, take-off of bacteria and viruses, survival of microbes, spread of plant pathogens in space and time, long-distance spore transport, and microbes in the upper atmosphere and beyond. Up-to-date and timely information on these subjects cannot be found easily anywhere else. Anyone interested in learning about the multitudes of microorganisms in the earth's atmosphere, their means of getting and staying there, their potential dangers to man, other animals, and to plants will find this symposium volume filled with informative and stimulating ideas.

—CLARK T. ROGERSON

RADIOECOLOGY OF AQUATIC ORGANISMS

By G. G. Polikarpov (translated from the Russian by Scripta Technica Ltd., London; English translation edited by Vincent Schultz and Alfred W. Klement, Jr.). 314 pages; illustrated, graphs and tables; references. Reinhold, New York, 1966.

This English translation is of the author's revised edition. In the preface the author indicates that at the present stage of development of radioecology of aquatic organisms attention is centered on the following topics: (1) Kinetic and physico-chemical aspects; (2) The capacity of aquatic organisms to concentrate radionuclides; (3) The role of aquatic organisms in the migration and distribution of natural and artificial radionuclides; (4) The radioactivity of acquatic organisms under natural conditions; (5) The radiosensitivity of aquatic organisms; (6) The effect of radionuclides on populations and biocoenoses. The book has four parts: Part I, Introduction, in which the subject matter and scope of marine radioecology are treated; Part II, Accumulation of radioactive substances by marine organisms, primarily a full data report on the concentration factors of radioactive isotopes and their carriers from eight groups of the periodic system; Part III, The effect of nuclear radiation on marine organisms —deals primarily with the effect on aquatic organisms of single dose external irradiation and of chromic ionizing irradiation; Part IV, Conclusion—achievements and future perspectives. Stress is placed on the necessity of wide investigation in the field of marine radioecology. This book is intended for specialists in the field of radioecology, radiobiology, hydrobiology, ecology, oceanology, biogeochemistry and conservation of natural resources. It is also useful as a text or reference for teachers and students of nuclear and marine sciences.

—WILLIAM A. SHERWOOD

THE AGARICACEAE OF MICHIGAN

By C. H. Kauffman. Vol. 1, 924 pages; 1 portrait; indexed. Vol. 2, 172 halftone plates. Johnson Reprint, New York, 1967 reprint of 1918 edition. Vol. 1 $25.00, Vol. 2 $12.50.

In the fifty years since Kauffman's "mushroom" book appeared it has been and remains the best text for general identification of gilled mushrooms in midwestern and eastern North America. It contains clear and usable keys to genera and species, the descriptions are exceptional, and more species are included than in any other American mushroom book. The classification of course is out of date and many more species are now known. Still, when attempting to identify an unknown gilled mushroom, it is the best book to try out first. The 172 black-and-white photographs were poorly reproduced in the original (1918) edition and have not been improved in the reprint; they are not very useful as an aid to identification.

—CLARK T. ROGERSON

TEXTBOOK OF THEORETICAL BOTANY, Volume Three (Part One)

By R. C. McLean and W. R. Ivimey-Cook. 1108 pages (paginated 2205 through 3313); illustrated; indexed. Longmans Green & Co., Ltd., London, 1967, price not stated.

The third volume of this monumental work contains (Part One) what amounts to a complete 400-page text of paleobotany, conveniently divided into four sections, the Paleozoic Era, the Mesozoic Era, the Cenozoic Era, and the Quaternary Era. Each era is subdivided into a discussion of geological periods. The book originates in England and the terms for the time scale do not always coincide with American equivalents, especially in the Cenozoic Era where the subdivisions are considered "epochs" of the Tertiary Period.

A complete and up-to-date revision of paleobotanical texts should take into consideration all changes and revisions that appeared during the past decade, an almost impossible task. The authors, nevertheless, incorporate some of the most recent researches, resulting in adjustments of taxonomic affinity and phylogenetic relationship *(Archaeopteris* ⇄ *Callixylon)*, but ignore others *(Ficus ceratops* = *Guara)*. As a whole, the treatment remains primarily a conventional review of the principal systematic groups with anatomical-morphological emphasis of phylogenetic-evolutionary changes from the Devonian Period through the Mesozoic Era.

A refreshing innovation is the space of 100 pages devoted to the Cenozoic Era, a topic hitherto nearly ignored, or abstracted within a few pages, in earlier (especially North American) texts. Our entire fossil flora represents ancestral forms of the modern vegetation, and the botanist or plant taxonomist is often interested in the immediate phylogeny of the living angiosperms and other vegetation. He can find answers to his inquiry only in compressions of the Tertiary and Cretaceous periods of no more than 80 million years ago. In recognition of this fact, the detailed development of fossil floras, especially the Neo-Tropical-, Arcto-, and Madro-Tertiary Geofloras, dispersal, paleoclimates, and paleoecology, represent an acknowledgment of the intense research of our western paleobotanists (R. W. Chaney, I. D. Axelrod, H. D. MacGinitie, and others). Worldwide correlation of Tertiary plant distribution includes European, North American, and Asiatic floras. Among other well-presented topics are the origin of angiosperms, the significance of lignite beds in Europe and North America, the origin of amber and its flora, and the implications of palynology, especially during the Holocene. As reading matter, as a basis to a better understanding of our modern flora, and as a purely paleobotanical text, the book, in my opinion, has merits exceeding any comparable volume.

—HERMAN F. BECKER

PLEISTOCENE EXTINCTIONS: The Search for a Cause

P. S. Martin and H. E. Wright, Jr., Editors. 453 pages; illustrated; bibliography; indexed. Yale University Press, 1968, $12.50.

This is Volume 6 of the Proceedings of the VII Congress of the International Association for Quaternary Research, sponsored by the National Academy of Sciences-National Research Council. The editors introduce the book with a "bestiary" for Pleistocene biologists which contains the names, and sometimes descriptions, of extinct vertebrates, followed by 17 papers of various authors on "Facets of the Problem" and "Regional Aspects and Case Histories."

Only one chapter—by Estella B. Leopold of the United States Geological Survey, Denver, Colorado—is devoted to Late-Cenozoic Patterns of Plant Extinction, based on studies for North America and Europe, primarily Poland. Of European paleobotanists, Polish members are perhaps the most active, judging by volume and quality of their publications. The author of this chapter is a palynologist with most of her North

American work based on pollen profiles for the determination of floristic succession. On the basis of generic identifications, changes of climatic regimes are determined, especially during late glacial and early postglacial stages of the ice age. Geographic-climatic factors influenced the rates of floristic change resulting in dispersal and extinction, and preparing in their later stages conditions as we find them today. Paleoecological considerations are interwoven throughout the text, allowing for excellent comparison with modern conditions. Figures and graphs showing plant distribution patterns, decreasing and increasing species elements, temperature charts, tables and statistics, make the work one of the most encompassing, if technical, summaries of this field in recent years, scholarly interpreted by the author. A bibliography of 86 references challenges the reader to enlarge his knowledge in specific areas of interest.

—HERMAN F. BECKER

QUATERNARY PALEOECOLOGY

E. J. Cushing and H. E. Wright, Jr., Editors. 433 pages; illustrated; references; indexed. Yale University Press, 1968, $15.00.

This is Volume 7 of the Proceedings of the VII Congress of the International Association for Quaternary Research, sponsored by the National Academy of Sciences-National Research Council. It presents 23 papers as a symposium on relations of the Late Wisconsin vegetational history to the glacial sequence in the Great Lakes region. Its four major sections are concerned with late glacial climates and floral chronology, with methodology, regional studies, and climatic history. Many contributors to this symposium are well-known palynologists and ecologists of the United States (Margaret B. Davis, J. Terasmae, Grace C. Brush), but others lend the book a truly international character through their discussions of Pleistocene floristic problems from Belgium, Czechoslovakia, England, Germany, Guatemala, El Salvador, and Turkey. Included are papers on glacial vegetation and climates in the southeastern United States, pollen stratigraphy of western Long Island and eastern Staten Island, New York, and fossil and Recent palynology of the Sierra Nevada. As expected, the papers are uniformly technical, presupposing a basic knowledge of paleoecology and all its ramifications. Consequently it is not feasible to evaluate each paper separately, but as a unit the symposium supplies a convenient summary of the most recent research and available information. Each topic is followed by numerous current references for verification or stimulation to further study in specific areas. The only discordant note is the practice of presenting nearly all column-form legends to the pollen profiles upside down, necessitating a turning of the book. In its diversity, scope, and scholarly presentation, the volume furnishes an excellent expansion as a text to Late Paleoecology.

—HERMAN F. BECKER

Books Briefly Noted

GUIDE TO GRADUATE STUDY IN BOTANY FOR THE UNITED STATES: 1966

Edited by Adolph Hecht. [xii] + 48 pages. Publ. Bot. Soc. America, Misc. Series No. 145, University of Indiana, Bloomington, 1967, $3.00.

This alphabetical list of more than a hundred university departments of botany and graduate centers (including The New York Botanical Garden!) will be very helpful for prospective graduate students—or anyone else—who needs to find out about opportunities and facilities for advanced work throughout the United States. The entries for each institution include its name and address, the correct name of the department, its chairman or head, and the fields of specialization represented. Biographical information is given about each faculty member, as well as the titles of doctoral theses prepared under his direction in recent years. This invaluable publication, which brings together in an orderly manner an enormous amount of information not otherwise available, stands as a monument to the editor and to the Botanical Society of America.

FUNDAMENTAL PRINCIPLES OF BACTERIOLOGY (6th revised edition)

By A. J. Salle. 822 pages; illustrated; indexed. McGraw-Hill, New York, 1967, $12.50.

Each chapter has been revised and rewritten to bring it up to date. The author was assisted by Dr. C. E. Zobell, who rewrote the chapter on the bacteriology of the sea; by Dr. E. E. Sercarz and Dr. C. R. Manclark, who are responsible for the chapter on immunity and immune response; and by Dr. W. R. Romig, who revised the chapter dealing with bacterial viruses and bacterial genetics. The book is intended for the non-medical student.

BIOCHEMISTRY OF SOME FOODBORNE MICROBIAL TOXINS

Edited by Richard I. Mateles and Gerald N. Wogan. 171 pages; illustrated; indexed. MIT Press, Cambridge, Mass., 1967, $7.50.

The papers contained in this book were presented at a Symposium on Microbial Toxins held in New York City on September 12, 1966, during the annual meeting of the American Chemical Society. The toxins discussed include the toxins of the bacteria *Staphylococcus aureus* and *Clostridium botulinum;* certain algal toxins; and several fungal toxins, sporidesmins, furocoumarins, ochratoxin; and an estrogenic substance from *Fusarium* and some aflatoxin-like compounds from Japanese industrial molds.

THE GLORY OF THE TREE

By B. K. Boom and H. Kleijn. 128 pages; illustrated; indexed. Doubleday, New York, 1966, $12.95.

This book by two Dutch authors describes the native and introduced trees of western and southern Europe and of North America, arranged according to families and genera. The 194 fine color photographs by G. D. Swanenburg de Veye are not keyed to the text and are referred to by number only, requiring a search to match the photograph to its description; this is unfortunate in a book intended "to add to the knowledge of the interested hiker and nature lover." The drawings of leaf shapes, flowers, and fruits are included with the text. A list of major botanical gardens and collections of hardy woody plants in the United States, Canada, and Europe, and a list of trees shown on postage stamps appear at the back of the book; also a bibliography of recent books about trees.

FANTASTIC TREES

By Edwin A. Menninger. 304 pages; illustrated; indexed. Viking, New York, 1967, $8.95.

Dr. Menninger, the author of several books about tropical and subtropical trees, has now produced a most interesting account of strange and unusual trees from all parts of the world; many excellent photographs, a bibliography, and notes on each chapter at the end of the book.

HOW TO CHOOSE AND USE SHRUBS AND TREES

By Beryl Guertner. 128 pages; illustrated. Grenville, Sydney, Australia (dist. by Leisure Time Books, New Rochelle, N. Y.), 1967, $5.50.

Beryl Guertner is the editor of *Australian House and Garden.* Although the book is intended for gardeners in Australia and New Zealand, it would also be useful in the United States. The information is well presented, with many photographs and some good diagrams and line drawings.

SHRUBS IN COLOUR

By A. G. L. Hellyer. 128 pages; illustrated; indexed. Doubleday, New York, 1966, $8.95.

A reprint of the 1965 London edition by Collingridge; the information applies mainly to conditions in Britain. The shrubs are arranged in alphabetical order by their Latin names, with a brief description and the growing conditions needed. There are beautiful colored

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illustrations of a flowering branch of each shrub, painted by Cynthia Newsome-Taylor. Smaller black-and-white drawings by G. R. Kingbourn show the habit of growth of each plant described.

HILL COUNTRY HARVEST

By Hal Borland. 377 pages. Lippincott, Philadelphia, 1967, $5.95.

A collection of essays taken from Mr. Borland's weekly newspaper columns written over the last ten years, the book is full of country lore and descriptions of the people, animals, and plants of the Berkshires where the author now lives.

CORRECTION

Three photographs in the preceding *Garden Journal* (Vol. 17, No. 3 & 4), bore incorrect captions. The cover photograph (described on page 77) is of *Acer saccharinum*, silver maple (not *A. saccharum*, sugar maple). The photograph on page 87 is of *Acer rubrum*, red maple (not *A. platanoides*, Norway maple). Dr. Benedict A. Hall, author of "Flower Structure and Breeding Systems in the Maples," is not responsible for the errors.

The photograph on page 90 is of *Sequoiadendron giganteum* (not *Sequoia gigantea*).

Books for Children

THE FIRST BOOK OF FRUITS, by Barbara L. Beck; illustrated by Page Cary. 63 pages; illustrated; indexed. Franklin Watts, New York, 1967. For each of various well-known families of fruits the author gives a brief general note, followed by a more detailed discussion of several particular fruits within a family. Information on each family includes its history, where it is grown, etc. The last portion of the book is an interesting section entitled "Fruits Popular in Other Parts of the World," which discusses such exotic fruits as papayas, guavas, and litchi nuts. Ages 8-10.

I LIKE VEGETABLES, by Sharon Lerner. 32 pages; water-color illustrations. Lerner, Minneapolis, 1967, $3.95. A short sketch about several common garden vegetables, telling which part of the plant is eaten, ways in which it may be prepared for eating, a few words about its history. The colorful and attractive illustrations are more decorative than informative. Ages 6-7.

THE BEGINNING KNOWLEDGE BOOK OF BACKYARD FLOWERS, by Polly Hathaway; illustrated in color by Paul Mina Mora. Macmillan, New York, 1965. Several common garden flowers are briefly described with pointers on how and when they should be planted. For each plant discussed there is an illustration of the flower and seed and usually an illustration about how it should be planted. Ages 7-9.

FLOWERPOT GARDENS, by Clyde Robert Bulla; illustrated by Henry Evans. 50 pages. Crowell, New York, 1967, $3.75. Following a brief general introduction, this book suggests and describes some plants that can be successfully grown indoors. The author gives a few simple tips for growing each. The illustrations are attractive one-color prints with a minimum of detail. Ages 8-10.

ADVENTURES WITH FLOWERS, by Elizabeth T. Billington; illustrated by Arnold Dobrin. 60 pages. Warne, New York, 1966, $2.95. Informative material about plants and plant projects, including a brief history of plants, plant classification, parts of plants and their uses. Projects include organizing a flower show, growing plants indoors, and flower arranging. A simple illustrated glossary is included. Ages 8-11.

A GUIDE TO NATURE PROJECTS, by Ted S. Pettit; illustrated by Walt Wenzel. 316 pages; indexed. Norton, New York, 1966, $3.95. Nature projects in such varied areas as rocks and soils, plants, and animals are presented. Directions for the projects are detailed and clear. The illustrations are simple black-and-white line drawings which well illustrate the activities. The chapter on "Plantlife" includes experiments to show a plant's need for water and light, collecting leaves and making leaf prints, and making a terrarium and a fernery. Ages 10 and up.

A TREE CALLED MOSES, by Laura Nelson Baker; illustrated by Penelope Naylor. 69 pages. Atheneum, New York, 1966, $3.50. In biographical style, Mrs. Baker has written the life history of a giant sequoia. Not only is this an informative sketch of the development of the tree, but it is a fine picture of the natural history of the area. The illustrations are clear black-and-white line drawings, appropriate to the text. Ages 10 and up.

PLAY WITH TREES, by Millicent E. Selsam; illustrated by Fred F. Scherer. 64 pages. Morrow, New York, 1950, $2.94. In this fine standard book on trees, the author gives detailed information on various parts of a tree, as well as simple projects to do in connection with the text. The black-and-white sketches are good illustrations of the text. Ages 8-11.

THE STRANGLER FIG AND OTHER STRANGE PLANTS, by Olive L. Earle; illustrated by the author. 64 pages; indexed. Morrow, New York, 1967, $2.95. This most interesting book carefully describes epiphytic, parasitic, and saprophytic plants, some common, some less well known. The text is clear and well written. The black-and-white illustrations are well executed and give excellent detail. Ages 9-11.

MILKWEED, by Millicent E. Selsam; photographs by Jerome Wexler. 45 pages. Morrow, New York, 1967, $3.95. The author carefully follows the life cycle of the milkweed plant, describing its development in clear detail. She also indicates the usefulness of the plant. The illustrations, one on each page, are very excellent photographs; a few are in color. Ages 7-9.

LIFE IN THE DESERT, by Peggy Larson; illustrated by Robert Borja. 63 pages; indexed. Children's Press, Chicago, 1967. Plant life and animal life of our Southwestern deserts are described in considerable detail, including discussions of their usefulness to man. Desert cacti, flowers, and trees are included. The text is appropriately illustrated with color photographs. Ages 9-12.

DESERTS, by Delia Goetz; illustrated by Louis Darling. 64 pages. Morrow, New York, 1956, $2.94. A well-written book which describes desert life in various parts of the world; illustrations are excellent. Ages 8-11.

THE ARCTIC TUNDRA, by Delia Goetz; illustrated by Louis Darling. 64 pages. Morrow, New York, 1958, $2.94. Descriptions of the plant, animal, and human life of the Arctic tundra; illustrations are excellent. Ages 8-11.

LIFE IN A POND, by Carmelita Klipple Robinson and Gordon E. Burks; illustrated in color by Marjorie Hartwell. 32 pages. Golden Press, New York, 1967. This easy-to-read book is mainly about the animal life in and around a small freshwater pond. A short section on the plant life is included. Ages 6-7.

THE RIDDLE OF SEEDS, by Winifred G. Hammond. 63 pages. Coward-McCann, New York, 1965. The young reader is introduced to various types of seeds, parts of seeds, seed dispersal, seed uses, and so forth. Following each section is a suggestion of a project to illustrate the text. Necessary materials and procedures are given in simple detail. Illustrated with black-and-white photographs. Ages 8-10.

PLAY WITH SEEDS, by Millicent E. Selsam; illustrated by Helen Ludwig. 96 pages; indexed. Morrow, New York, 1957, $3.14. This standard book gives good background material on seeds and includes a lengthy section devoted to simple seed experiments. Illustrations are given in fine detail. Ages 9-11.

THE WONDERS OF NATURE, by Geoffrey Coe, Grace F. Ferguson and Amy E. Jensen; illustrated by Cynthia Iliff Koehler and Alvin Koehler. 160 pages; indexed. Grosset & Dunlap, New York, 1966. This book deals with the world of plants only. It includes sections on "Mushrooms, Ferns and Mosses," "Wild Flowers," and "Trees," each written by a different author. Sections include a general discussion of a particular plant, detailed illustrations (some in color) and activities to be carried out in conjunction with the text. Ages 11 and up.

THE PLANT WORLD (Vol. 2 of the Basic Biology in Color Series), by Jean Vallin; edited by Charles D. Heath; translated by L. F. Wise. 108 pages; indexed. Sterling, New York, 1967, $3.95. Good coverage of plants—clear color photos, labeled diagrams, detailed text, some simple experiments to illustrate the text. Then follow sections on pollination, dispersal of fruits and seeds, vegetative propagation. The final sections include discussions and illustrations of ferns, mosses, mushrooms, and lichens. The color illustrations are particularly clear and well done. Ages 12 and up.

THE WORLD OF PLANTS; FOUNDATIONS OF BOTANY, by Michael Gabb and Michael Chinery. 160 pages; illustrated; indexed. (Foundations of Science Library—The Biological Sciences). Sampson Low, Marston and Co., London, 1966, $5.25. An extensive introductory presentation of the entire plant kingdom is given in this book. It covers such areas as "How Plants Live," "The Structure of the Flowering Plant," "The Classification of Plants," "Non-Flowering Plants," etc. The text is detailed and the color illustrations are clear and appropriate. Ages 12 and up.

THE GOLDEN BOOK OF BIOLOGY; AN INTRODUCTION TO THE WONDERS OF LIFE, by Gerald Ames and Rose Wyler; illustrated by Charles Harper. 99 pages; indexed. Golden Press, New York, revised 1967, $3.95. A general biology book in which plants are covered in relationship to animals and their environment. The modern illustrations are colorful and attractive but not necessarily informative. Ages 11 and up.

PLANTS IN TIME: THEIR HISTORY AND MYSTERY, by Margaret Cosgrove; illustrated by the author. 63 pages; indexed. Dodd, Mead & Co., New York, 1967, $3.25. An interesting introduction to paleobotany for children is presented. The material is clear and well written. The two-color illustrations are appropriate to the text. Ages 11 and up.

NABOB AND THE GERANIUM, by Judith Ransome Miller; illustrated by Marilyn Neuhart. 44 pages. Golden Gate Junior Books, San Carlos, California, 1967, $3.50. In story form the author and illustrator attempt to explain the difference between plants and animals and, further to show the differences and similarities within the animal kingdom. While it is an interesting presentation it is not particularly clear. Ages 6-8.

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trated by living specimens, could be provided for pupils from New York and its vicinity, and thus a great and desirable impetus might be given to the pursuit of one of the most useful and interesting of sciences.

Students in medicine and pharmacy approach the subject of botany with a particular object in view. Plants of medicinal value have for them a special importance. With ample means at command it would be easy to obtain an abundant representation of plants of this nature, without prejudice to the purely scientific character of the garden, thus securing for the institution the highest degree of pharmaceutic usefulness, and making it an invaluable auxiliary to our admirable medical schools.

The horticultural uses of a great botanic garden are more or less indirect, and yet of the utmost consequence to all practical gardeners. The hot-houses of such an institution should be models of construction and management ; the methods of cultivation should be the best that science and experience can dictate ; the director and his deputies should be men of the highest ability in their calling. It follows, therefore, that such a garden becomes, of necessity, a sort of College of Horticulture, service in which for a reasonable term would be the best possible preparation for practising the gardener's art. Moreover, the primary object of a botanic garden includes the introduction and cultivation of new and untried plants, and consequently the florist would find gathered there a multitude of rare species, many of which might prove desirable for ornamental cultivation.

The remaining use of a botanic garden, as a place of agreeable and profitable resort for the general public, is by no means to be lightly estimated. The large attendance at our orchid and chrysanthemum shows, the curiosity excited by the rare plants cultivated for some seasons past in Union Square by the park authorities, the increased interest given to Central Park by the attachment of name-plates to many of the trees—these circumstances combine to prove beyond a doubt that the public at large would keenly appreciate a public garden where, thanks to systematic grouping and a liberal use of labels, a considerable acquaintance with plants might be readily and pleasantly acquired. It is aside from the true purpose of a botanic garden to give any preference to merely ornamental plants, or to aim at any of the showy effects which are legitimate and desirable in parks and pleasure-grounds ; but Nature abounds in rare and remarkable trees and herbs, wholly proper for such a garden, and admirably calculated to excite a lively interest in even the most indifferent visitor.

To serve adequately the various uses here indicated a botanic garden requires a somewhat spacious site. The Royal Botanic Garden at Kew comprises sixty-seven acres, an area ample for its purposes. Fifty acres might be considered a reasonable amount of land for a New York botanic garden ; half as much could be made to answer a good purpose ; seventy-five acres would be none too much for its ultimate highest development. Several available sites might be set off from the outlying park lands recently acquired by the city. Apart from these it is doubtful if sufficient ground could be secured within the city limits except at most exorbitant cost. It might, therefore, be found wisest to establish the garden somewhere in the suburbs, special care being taken to select a place easily accessible at all seasons of the year. The question of site, however, is secondary to the question of funds, and can be readily solved whenever the money is forthcoming.

More than one of our wealthy citizens enjoys public repute as a generous patron of horticulture. Scarcely any are wholly indifferent to it. Surely the scheme of a public botanic garden should commend itself to all. Two American institutions of kindred nature—the Shaw Garden at St. Louis and the Arnold Arboretum at Brookline, Mass.—are already in successful operation, honorably perpetuating the names of their respective originators, and benefiting at once the student and the general public. These are modest affairs, remotely and inconspicuously situated ; but a botanic garden of the highest class, established in New York City or its immediate neighborhood, would be placed at the best imaginable point to win a lasting reputation for itself and its founder, both in this country and abroad.

TORREYA TAXIFOLIA, from "The Silva of North America" by Charles Sprague Sargent, Vol. 10, 1896.

Reproduction of the "Appeal for a Public Botanic Garden in New York City" circulated by the Torrey Botanical Club in 1889. The document was printed in black ink on paper probably ecru in color; the copy on each of its four small pages was embellished by a rust-red border. Our irreplaceable specimen has discolored with age, but it is still a handsome publication.

TORREY BOTANICAL CLUB.

APPEAL

FOR A

PUBLIC BOTANIC GARDEN

IN

NEW YORK CITY.

At a regular meeting of the Torrey Botanical Club, held January 8, 1889, the subjoined appeal was unanimously adopted and ordered to be printed for general circulation.

THE accumulation of wealth and the growth of public spirit in this metropolis make it reasonably certain that we shall have, sooner or later, a public botanic garden of the highest class. The sole question at present seems to be whether we shall have it very shortly, or wait another generation for its establishment.

Strictly speaking, a garden of this sort is a scientific and educational institution, quite as much so as a library or a college, and for its foundation and maintenance the public may properly look to the sources from which so many of our universities and libraries have been derived. A garden such as New York City ought to have would fully equal in value such distinguished institutions as Cornell University, Vassar College, or the Astor and Lenox libraries. In a sense it would even surpass them in importance, for it would occupy an educational and scientific field at present very inadequately cultivated in this country.

Such a garden might be established and maintained by one man of wealth or by a corporation of citizens. An institution on the latter basis will naturally arise when several men of means shall have made plant collections too important to be lightly dispersed. One, let us say, will accumulate orchids, another palms, a third ferns, and a fourth liliaceous plants. These or similar collections, united by common consent, properly housed, and provided with a sufficient maintenance fund, would form the nucleus of an institution, essentially horticultural and popular in its inception, but susceptible, under wise direction, of ultimately attaining a high degree of scientific usefulness. A third method of securing a botanic garden would be by municipal appropriation and under municipal management. The city might, at least, afford valuable aid to the project by giving a site from the lands appropriated for park purposes ; and an annual subsidy of fixed amount from the city (or State) treasury would also be an important assistance.

The uses of a botanic garden may be reckoned as of four sorts. First and foremost is the purely scientific and educational use. Subsidiary to this, but still of a marked degree of importance, are the pharmaceutical and horticultural uses, and, lastly, the general use as a place of agreeable resort for the public at large.

It is obvious that a considerable collection of living plants, arranged with scientific method and representing with tolerable completeness the various classes and orders of the vegetable kingdom, must be of immense interest and value to every practical botanist. Such a garden as New York might have would speedily become a Mecca for the botanists of America, and for those of the Old World also if due attention were paid, as it should be, to making the representation of distinctively American plants as full as possible. To students of botany in the numerous schools and colleges within a hundred miles of us, such a garden would be of the greatest benefit. Courses of instruction, vividly illus-

(concluded on inside back cover)